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BATTLING WITH THE PANAMA SLIDES

By WILLIAM JOSEPH SHOWALTER

Author of "The Panama Canal" and "The Countries of the Caribbean," in the NATIONAL GEOGRAPHIC MAGAZINE

HE only reason why ships have not been using the Panama Canal since last October is that Nature has been battling to the last ditch in her efforts to thwart the purpose of man to put a shipway through the vitals of proud old Culebra Mountain. But for this great battle, Culebra Cut would have been a finished job two years ago.

The weapons used by Nature in her efforts to confound the plans of the canal engineers have been slides and breaks in the banks of the canal, and effective weapons indeed have they proven. How, with them, she has stood between the canal army and the completion of the task to which it addressed itself constitutes the most thrilling episode in the history of canal engineering.

Over 250 acres of ground lying outside of the intended banks of the canal, and containing over 30 million cubic yards of material, have swept, with silent but terrific force, down into the canal. Now this onslaught has demoralized an entire railroad system; now it has put the compressed air and water systems out of commission; now it has bottled up one end of Culebra Cut with an avalanche of debris; now it has imprisoned dirt trains and wrecked steam shovels. But with all the wreck and ruin and chaos there have been men with wills of iron who have met each new situation with a new spirit of determination; men who have never

permitted any catastrophe to turn them aside from their ultimate purpose; men whose achievements in the face of unprecedented difficulties make a story as inspiring as anything in human history.

No one who failed to visit the Isthmus during the construction period can understand the full import of the coming of these slides into Culebra Cut. With each passing year they have renewed and redoubled their attacks on the canal plans. They seem to be maneuvered by the hand of some great marshal and sent forth to the fray in every way calculated to put the canal engineers to discomfiture.

Now they are quiescent, attempting to lull the engineers into a false security; now they make a feint, stopping short of an actual conflict; now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move; now they set up the appearance of being rendered thoroughly harmless by allowing dikes of basalt to peep out which seem to tie them to the bowels of the earth, only to destroy the hopes which these dikes arouse in the hearts of the besiegers, by shearing them off as if they were but pipe-stems, and then flowing, unrestrained, into the cut.

Consider what the removal of 30 million cubic yards of material means. It is enough to build a sort of Chinese wall 7 feet thick and 7 feet high reaching from New York to San Francisco. It is

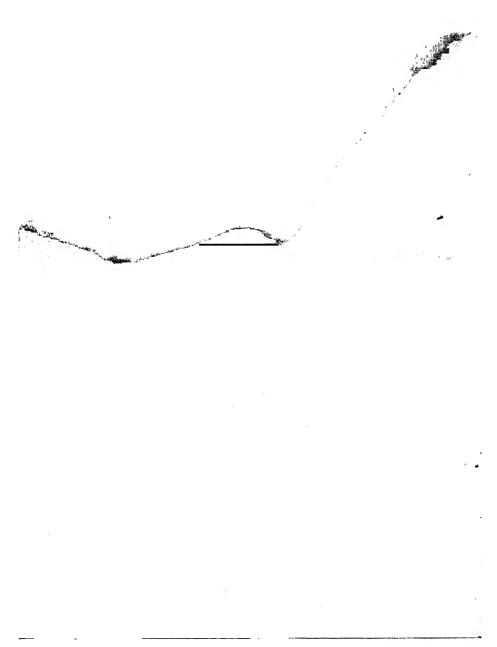


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THE DEEPEST PART OF CULEBRA CUT

Looking south from the west bank of the canal, near Contractor's Hill, Cucaracha slide shows on the left side of the picture. Some 10 million pounds of dynamite have been exploded in Culebra and enough material removed to make 26 pyramids, each as large as the Great Pyramid of Cheops, in Egypt, or 2,500 shafts, each as large as the Washington Monument



more than could be drawn by all the horses and mules in the United States. It would fill a million and a half big Lidgerwood cars, enough to make a string 12,000 miles long. These figures show that the mere getting rid of this surplus material is no mean job.

But when you reflect that each yard of this sliding material has rendered doubly difficult the getting out of three yards of other material, the true meaning of the slides will begin to appear. There have been times when 170 trains were going out of the cut one day at the south end, only to be stopped entirely the next day by the Cucaracha slide getting busy. Now there may be a dozen tracks in use in the cut, and 24 hours later half of these will be out of commission. That is what makes the slides such serious things to combat.

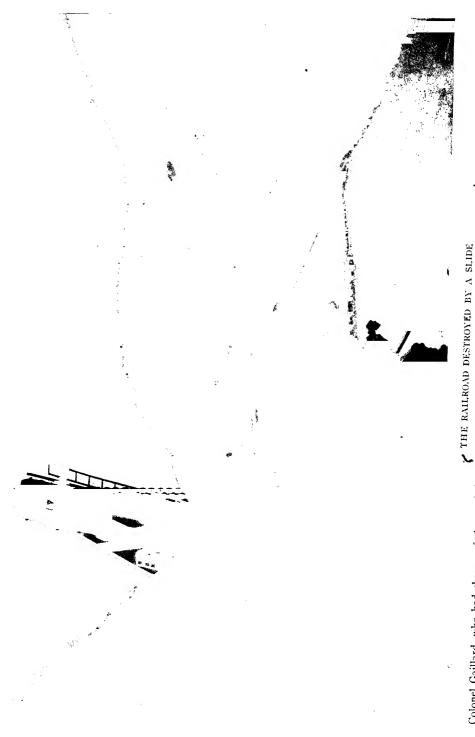
THE GREATEST ENGINEERING WONDER OF THE AGE

It is no wonder that the lamented Colonel Gaillard lost his health and his

life fighting them. It is no wonder that: Colonel Goethals has aged 20 years in six while struggling with them. But it is a wonder, the greatest engineering wonder of the age, that in spite of these difficulties they have been able to remove 106 million cubic yards of material from the cut in less time than it was estimated that they could remove 53 million cubic yards. And this wonder grows when I look at their cost sheets and see them removing a cubic yard for an average of 60-odd cents, when it was estimated that, unhindered by slides, the cost of removing a cubic yard would be 98 cents.

Speaking of the terrific strain involved upon those who are responsible for the battle with the slides at Panama, no incident in my life can stand out more vividly than one I will now relate, illustrating the meaning of it all to the engineers. Cucaracha slide resumed her old tricks when I was on the Isthmus last May. She had been quiescent for some time, and it was believed that she had retired

from the fray for good and all.



Colonel Gaillard, who had charge of the work in Cuebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before

Culebra Cut began to look like a finished job, with only a little hump in the middle mile to be taken off. Then one night, while the canal army was asleep, she poured down into the south end of the cut an avalanche of material that filled it up to the 67-foot level, bottled up the railroad exits from that end, and did sundry other evil things to the plans of the engineers (see page 146).

When I heard about it I went up to Culebra to talk with Colonel Goethals as to its bearing on the immediate future. After passing the time of day I asked him how he was, to which he replied:

"Well, about the best way I can express it is to say that I am 'home-sick.' Cucaracha looks bad, but she is not by any means the greatest of my woes. I trampled over her this morning, and the basalt dikes that are peeping out seem to indicate that she will be 'dead' before very long. But over here on this side of the cut," pointing out the window of his office as he spoke, "there is beginning to show an indication of a new break, and if the actualities prove as bad as the indications suggest, it will outdo anything we have had to contend with yet."

And as he spoke I saw the tears well up in the eyes of that man of iron, and I understood what those slides were costing him. I knew then whence had gone but buoyancy of youth which I had met in 1908 and that enthusiasm of purpose which I had seen in 1910. Now instead there was the grim determination of a veteran of a thousand conflicts, who would fight on to the end only because Duty's voice ever spoke louder in his ear than Pleasure's.

NO ONE COULD FORETELL THE SLIDES

The determined character of the slides that beset the canal engineers is strikingly shown by the amount of their material that had to be removed in comparison with the total excavations for each year. Prior to 1910 they presented, no serious obstacle, since the canal was not deep enough to create the unbalanced condition necessary for their development. Up to that year the excavations on account of slides were only 7.87 per cent of the total excavations.

During 1910, however, they became more active, and seven weeks out of the 52 would have been required to take care of the 14.83 per cent of all excavations which represented the slide debris taken out. In 1911 there was a still greater activity in slides, and, omitting the extra difficulties they imposed, it required 13 weeks to take out the material they brought into the cut, this material amounting to 26.30 per cent of the total excavations for the year.

The succeeding year saw the cut going still deeper and the slides growing larger and still more bothersome, so that 34.5 per cent of the excavations of that year were of slide material, whose removal required 18 weeks.

During the year 1913 the cut approached final grade and the slides set a new record, requiring 46 per cent of the total excavations for the year, which accounts for 24 weeks' work.

The present year, beginning July 1, 1913, saw only two months required for the final bottom to be reached in the cut, outside of the material brought in by the slides, so that at least 44 weeks of this year are chargeable against the slides.

SLIDES HAVE DELAYED THE COMPLETION OF THE CUT BY 22 MONTHS

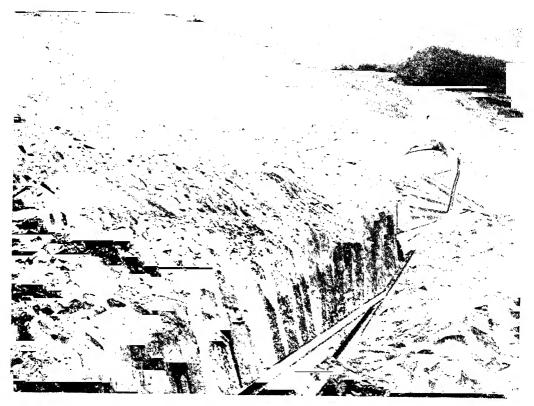
From all this it must appear that the bare work of removing the material from the cut brought into it by the slides, leaving entirely out of the reckoning the immense handicap in the prosecution of the regular work that they involved, held back the completion of the cut by 22 months at least.

It is certainly reasonable to suppose that all the delays the slides imposed held up the work by eight months, so that but for them we might have seen a cut through Culebra Mountain, with a bottom width of 300 feet, completed by January 1, 1912, in five years; whereas the most conservative estimate had set down eight and a half years to make a cut with a bottom width of 200 feet. As a matter of fact, the amount of material that was contained in the cut as originally planned, 53,800,000 cubic yards, was removed before the end of the calendar year 1910, or in less than four



BREAKS IN THE CANAL BANK DESTROY THE TRACKS

One type of slide was caused by cracks occurring in the banks of the canal, and often these were 300 or 400 feet back from the edge of the cut. The ground would settle, and after a time the whole mass would slide gracefully into the canal, wrecking the railroad tracks and enguling



A STEAM SHOVEL HALF BURIED BY A SLIDE

Many miles of railroad track and steam shovels by the dozen have been destroyed by slides in the cut. Often, however, the slide has bodily raised the bottom of the cut, leaving steam shovels standing on their tracks, hardly out of alignment, but 15 feet or more above the place where they should normally be.

years of actual work and at a total cost of about 50 million dollars.

One of the wonderful things about the building of the canal was how, in the face of all the unforeseen difficulties that the slide problem involved, Colonel Goethals and Colonel Gaillard were able to drive down unit cost as the mercury in the difficulty thermometer sped upward. In 1008 it was estimated that the cost of removing a yard of spoil would be around 08 cents for the whole cut.

For the fiscal year 1909 they hammered this cost down to 78% cents; the next year they lowered it to 73% cents; in 1911, although the slide problem became much more acute, they forced it still lower—to 63% cents.

But they were not satisfied even then; 1012 saw the slides more troublesome than ever, and in spite of this they forced the unit cost down to 54% cents. Than this, there is no prouder showing in the history of business economy or of engineering.

Even in 1913, with the slides requiring nearly half of all the work and imposing unprecedented difficulties upon the engineers, they managed to hold down the yardage cost to 59 cents. And that is why they were able to save 20 cents on every one of the 107 million cubic yards taken out of the Central Division up to July 1, 1913—enough in the aggregate to finance the removal of all the slides, with a handsome little nest-egg left over.

DIFFERENT VARIETIES OF SLIDES

The slides with which the canal engineers have had to deal in solving the problems of Culebra Cut are of four classes. The most troublesome of these



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are, more properly speaking, structural breaks.

As the big ditch neared final grade the depth was so great that the downward pressure from the top of the embankment forced the weak rock at the bottom to crumble, and this led to great fissures in the ground back some distance from the edge of the embankment. These would gradually widen, and the material would sweep downward and outward and upward into the bottom of the canal, often raising the bottom 10 to 20 feet higher than it was a few hours before.

The great slide on the west bank at Culebra, covering some 75 acres of ground and involving millions of cubic yards of material, is the best example of this kind of slide. Nearly half of all the sliding material on the canal strip was embraced in this great movement.

It began in 1907, and during the more than six years of its activity it required the dismantling and removal of half of the village of Culebra to keep out of its way. Now it was the American living quarters that had to go; now it was the big Y. M. C. A. club house, after being shored up repeatedly in the hope of saving it; now it was the penitentiary, and so on. If the cut had gone much deeper it might have been the very Administration Building itself that would have been next to go.

THE FAMOUS CUCARACHA SLIDE

The other principal type of slide is represented by Cucaracha, a mass of soft earth with no rock reaching down deep enough or holding strong enough to keep it from sliding in, slipping across a smooth surface beneath it.

Cucaracha scared out the French. It is said that when they were working along at her toe and she began to give them a tropical imitation of a glacier sliding down into a stream, they saw their visions of a sea-level canal disappearing into the realms of impossibility. At any rate, they promptly quit excavating at the bottom of Cucaracha and left her as a problem for the Americans; and a problem she declared herself to them back as far as 1905.

Cucaracha has been like the poor—a

problem always with the canal engineers. Every time they got a little nearer toward the final bottom of the cut, Cucaracha would take a fresh slide, sometimes shooting millions of yards of material down the embankment and across the cut with such force that her toe would turn to the opposite bank, some 60 feet or more (see page 146). She kept this up in season and out, bottling up the south end of the cut, and so preventing the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out. He is now inviting her to do her very worst. He has a dredging fleet ready to take her out as fast as she comes in, and it now looks as if she has slid until she can slide no more (see page 148).

Meanwhile Colonel Goethals, in keeping with a suggestion made by Division Engineer Cole, decided to attack Cucaracha in the rear. She had slid and kept a-sliding until she went away back past the summit of the hill, and so it was decided to sluice off all the material that would drain away from the canal.

The plan worked well, and Cucaracha, in her final struggle against the engineers, finds herself beset before and behind, and soon she will become a thing of the past forever. But during her unremitting fight she has shut up Culebra Cut dozens of times, has brought 50 acres of ground, scenery and all, into the cut, and has required the removal of some eight or nine million cubic yards of material.

Fortunately the two great hills, Gold Hill and Contractor's Hill, stand like Gibraltars, and rear their heads proudly above the majestic scene below. They seem to be of solid rock wherever there might be danger of slides if they were not. Gold Hill is flanked by Cucaracha on the south and by East Culebra slide on the north, but has never given any sign of wanting to join the flowing procession into the cut. It rises 652 feet above the sea and is the highest hill in the canal region.

HOW THE MOUNTAIN CAME TO MOHAMMED

The slides have played many fantastic tricks in the course of the construction



ere the cut was not impeded by the slides it looked just like this picture. When the water was let in about nine-tenths of the cut was in this condition



The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation, in order to prevent those small slides, that come down through erosion. When the ships of the future use the canal they will sail between banks of tropic green THE CUT AT BAS OBISPO, SHOWING DEEPEST PART OF THE EXCAVATION



SLIDES FROM BOTH BANKS BLOCK THE CANAL; SEPTEMBER 20, 1913

"The slides seem to be maneuvered by the hand of some great marshal and sent forth to prey in every way calculated to put the canal engineers to discomiture; now they are quiescent, attempting to lull the engineers into a false security; . . . now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move" (see text, page 133).

of the canal. At one time Cucaracha picked up a steam shovel, track and all, and moved it 50 feet away, but still standing ready for operation as though nothing had happened, except that it was cut off from the dirt-train tracks. At another place and time Mohammed did not have to go to the mountain, for it came to him; so at Panama a shovel was able to make a hundred trips or more back and forth along the base of a slide without moving a step closer to the dirt, for the slide came down just as fast as the shovel worked.

During their history the Culebra Cut slides destroyed over 200 miles of railroad track. Sometimes a slide would come down, forcing one track out of position, passing under the next one without disturbing it at all, and then upheaving the material under the third track mayhap as much as 10 or 20 feet.

All manner of efforts were put forth to prevent slides. It was once proposed that cutting off the top of the bank above the cut would prevent those that developed through structural breaks. But this work was vigorously prosecuted for awhile with no important bearing on the ultimate result. At another time it was suggested that a revenment of concrete along the banks of the cut would protect it, but this was a failure also. The water that seeped down from the surface got in behind the concrete and caused it to loosen its hold and scale off.

At another time it was suggested that letting water into the cut would tend to develop an equilibrium and thus prevent additional slides. But this method of treatment succeeded no better than those methods which were tried out before; and so the settled policy became one of inviting all slides that intended to come down to do so quickly, so as to have it all over with.

WHAT CAUSES THE SLIDES

The causes of the slides at Panama must be traced to the geologic history of the Isthmus. There are 11 groups of bedded rock and six of igneous rock on the canal line. The two oldest rocks are the Bas Obispo formation and the Las Cascadas agglomerate. Neither contains

any fossil remains, and so their age cannot be fixed with any degree of definiteness. The Bas Obispo formation is of volcanic origin and crops out at Bas Obispo, Miraflores, and Old Panama. The Las Cascadas agglomerate is made up of basalt breccia, cemented together with volcanic clay and tufa and other lava flows.

Culebra Cut contains fossils of sealiving animals, thus proving, along with other evidence, that this great barrier which has stood between man and his dream for more than four centuries was once at the bottom of the sea.

It is stated that Gold and Contractor's hills, which now stand as the huge posts of the Panama Gateway, are composed of comparatively young volcanic rock blown up to a height some 300 feet or more above their present summits, and that they settled down to their existing level soon thereafter. The evidence of the rocks of the Isthmus is that there were two eras of volcanic activity, the one of terrific force and the other much more gentle, with a long quiescent period between them.

During the first volcanic era islands arose in the shallow ocean that linked the Atlantic and the Pacific. During the second period the whole land arose and the rivers became active, assorting the rocks as they hurried to the sea. The original bed of the Chagres at Gatun, as it existed then, is now 375 feet below sealevel. After this the ground sank to 8 feet below its present level on the Atlantic side and to 25 feet below its present level on the Pacific side. This level seems to have been maintained until a time approximating the dawn of the Christian era, when it rose to the present level.

Interesting proof of this is afforded some 80 miles from Ancon. The Indians there have been using the contents of a shell mound, found at the base of a 75-foot hill, for burning lime. The plain here is about 25 feet above sea-level. The mound contains many varieties of shells and much broken crockery, indicating that it was once used as a kitchen midden. About 2 inches of soil cover these deposits, and near-by is a place which shows that it was used as a canoe



This slide "so prevented the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out" (see text, page 141). This is the last photograph taken before the cut was flooded



The slide completely blocked the canal, and, in the attempt to force a channel through it, a mass of dynamite was buried and exploded on October 16, 1913



This dredge came from the Pacific side, and across the slide can be seen the smoke-stacks of the dredge that came from the Atlantic through the Gatun locks. Note the pipe-line through which the dirt from the slide will be pumped away to a safe place.

landing, while the remains of an ancient fishing village are in evidence.

The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation in order to prevent those small slides that come down through erosion. As soon as the angle of repose is reached this work of tropical forestation will begin, and when the ships of the future use the canal they will sail between banks of tropic green except at those places where the living rock defies the efforts of the forester.

l can find no more striking way to convey to my readers the meaning of the slides at Panama than by asking them to remember that at one place where the consulting engineers said the slope should be such as to give a top width 670 feet that width is now 1,800 feet; the vastness of the difficulties created by this difference can thus be somewhat appreciated.

It is a most striking thing to look back to the days of the consulting engineers, in the light of what the completion of the canal has shown, and to see how well they appreciated conditions in Culebra Cut, especially those who advocated a sea-level canal. These men were so sure that they knew what was beneath the soil of Culebra Mountain that they did not hesitate to proclaim with confidence that Culebra Cut dug to 40 feet below the sea was no problem except that of removing material.

A member of the Isthmian Canal Commission of 1800-1901 testified that it was thoroughly known exactly what materials would be encountered in the cut, and the consulting engineers, taking their cue from this, reported that the whole proposition was an easy one. Henry Hunter, chief engineer of the Manchester Ship Canal, was so sure that a sea-level Culebra Cut would present no difficulties that he announced it as his belief that such a cut could be completed long before the locks of a lock canal could be built.

The entire majority declared that it was as clearly demonstrable as anything of Aich a nature could be that it would be possible to use a hundred steam shovels in the cut alone, and that a sealevel cut could be finished in 11 years at the outside.

One engineer laughed at the idea of en-

countering any trouble from Cucaracha slide. "Why, I have tramped over it every day for months, and with my experience with such slides I know that it is only a question of proper drainage."

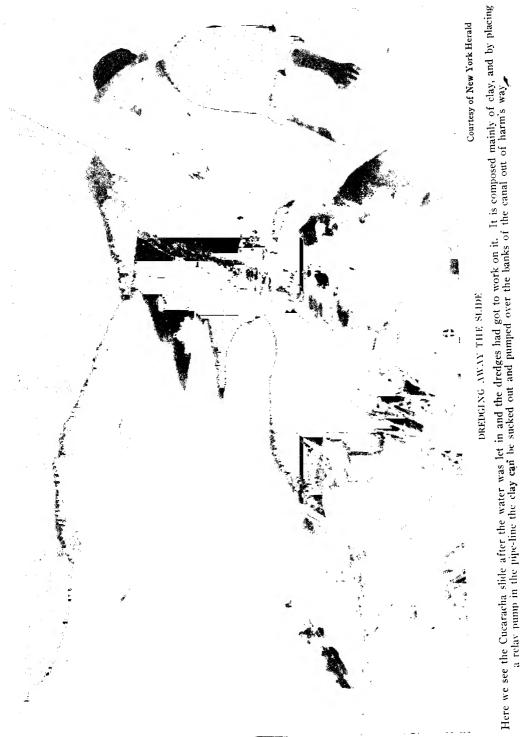
Never did any set of men miss a proper statement of conditions that would be encountered more widely than the majority of the board of consulting engineers. They said the banks would stand up; that there would be no slides; that a hundred steam shovels could be used in Culebra Cut; that the cut could be built to sca-level in less time than it would require to construct locks; that a sea-level cut would require the excavation of only 110 million cubic yards of earth.

The facts are that the banks failed to stand up, to the tune of 30 million cubic yards; that there have been over 250 acres of slides; that no more than 40 steam shovels ever could be worked in Culebra Cut; that locks a fourth larger than those the majority members of the board of consulting engineers had in mind were built in less time than even a lock-level cut was dug, and that a lock-level cut has required the excavation of almost as much material as they said a sea-level cut would require.

A FORTUNATE CHANGE OF PLAN

The American people may thank their stars that at such a juncture as we were facing at the time the consulting engineers made their report, there was a man in the White House and a man at the head of the War Department who dared ignore the recommendations of the majority of that board.

Had the change to a lock canal not been made we would have worked up to about the present time on a sea-level canal, digging a tremendous ditch all through that broad country from Gatun to Gamboa, 20-odd miles, building a sixmillion-dollar set of tidal locks at Sosa Hill, building a six-million-dollar masonry dam at Gamboa, and doing divers other things unnecessary to a lock canal, at a total cost of some \$50,000,000, only to find, after all, just as the French discovered, that a sea-level canal could not be built within the limit of money and patience set by the people behind the project.





STEAM SHOVELS REMOVING CUCARACHA SLIDE

This particular slide, one of the many, completely filled the canal. The flat cars are standing on the west bank of the canal, 70 feet above the bottom of the cut

We would either have been forced to acknowledge a humiliating defeat or to have started at this late date to transform the sea-level canal that was to have been into a lock canal such as we have now. It is very easy to imagine that, with a sea-level canal fiasco staring them in the face, the American people might not have been willing to accept the lock canal, with its Gatum Dam and its great locks, and there would have been no canal in the end.

WHY A SEA-LEVEL CANAL WAS IMPOSSIBLE

Let us consider for a moment, in view of what actual work has proven, how much more excavation would be required to bring the present cut to sea-level. We have seen that the slides have grown vastly more serious as the cut has deep-

During my last trip to the Isthmus I asked every engineer I met, from Colonel Goethals down, to estimate for me,

roughly, how much more material would have to be removed from the cut to bring it to sea-level. Not one of them would risk a prediction, but all agreed that it would be more than cross-section measurements plus the slide experience of the fiscal year 1913 would indicate.

Such a cross-section measurement would involve about 50 million cubic yards. Even if the slides were no worse than they were in 1913, the extra excavation which would be required to convert the present cut into a sea-level cut would amount to approximately 75 million cubic yards.

The probabilities, therefore, are, in the light of experience, that it would require the removal of as much more material as has been taken out to make a sea-level cut; in other words, that from the vantage point at which we stand today we might fairly conclude that a sea-level Culebra Cut would have required the excavation of 210 million cubic yards of



BUILDING THE A VOS ISLAND BREAKWATER

At both the Atlantic and Pacific ends of the canal great breakwaters have been built to afford protection to the shipping and to keep the channels free. This Naos breakwater at the Panama end is 17000 feet long and is built of material excavated from the Culebra Cut. The rock was dumped into the water from railroad trucks which ran along the wooden trestle shown in the picture.

material instead of the 110 million cubic yards the majority members of the board of consulting engineers fixed.

But suppose such a prospect would not have staggered the American people into a refusal to go further with a sea-level canal, what would we have had when it should be completed? A tortuous channel, with a tidal lock at the Pacific end in greater danger of destruction than those at Gatun; a masonry dam at Gamboa nearly twice as high as Gatun Dam and a much fairer mark for the dread man in the flying machine; a canal in which not one of the recently built big ships could be handled, making it out of date before its completion.

When the American people come to celebrate the opening of the present canal, they owe a hymn of thanksgiving to that happy fate that led them—yes, led them against their will—to build a lock canal at Panama. To have pursued the course the majority of us—for I am one of that majority—wanted the United States to pursue would have involved us in one of the most calamitous undertakings in all history.

The meaning of the slides cannot be misunderstood or misinterpreted. They mean that Nature would have interposed such tremendous obstacles in the way of a sea-level cut through Culebra Mountain that even the might and power and wealth of the giant of the household of

nations would have arrayed themselves against her in vain had that nation determined upon the wedding of the oceans by the commingling of their waters at Panama.

In conclusion, I wish to call attention to a story that seems to find acceptance in some quarters. It is to the effect that shipping and insurance circles stand in dread of slides in the future in the canal.

There are two reasons why there is not the slightest ground for that dread, even if there should be for the story. In the first place, the canal is not going to be pronounced a finished waterway until every yard of debris that can come in has arrived and has been removed. In the second place, the United States government has pledged its solemn word, through definite legislation, to indemnify any ship-owner for delays or damages caused by the canal or its operatives. And Uncle Sam makes the process of recovery easy and prompt in its action.

When the shipping of the world passes through the great waterway, some time this year, it will behold the most wonderful shipway that ever has opened its gates to the nations of the earth. And there will be read in the majestic proportions of the present Culebra Cut the reason why a sea-level canal was not built, and why it could not be built within the toiling and money-spending power of the United States.

THE PANAMA CANAL*

By LIEUT. COLONEL WILLIAM L. SIBERT, U. S. ARMY

ENGINEER IN CHARGE OF THE ATLANTIC DIVISION

For a map of the Panama Canal, see "Bird's-eye View of the Panama Canal," o by 18 inches, in National Geographic Magazine, February, 1912, and also "Map of Central America, etc.," 12 by 19 inches, in the February, 1913, number.

HE Panama Canal, as all know, is being built by the President of the United States through a commission of seven members, the chairman and chief engineer of which is Col. George W. Goethals, of the Corps of Engineers, United States Army. As a member of the commission and as divi-

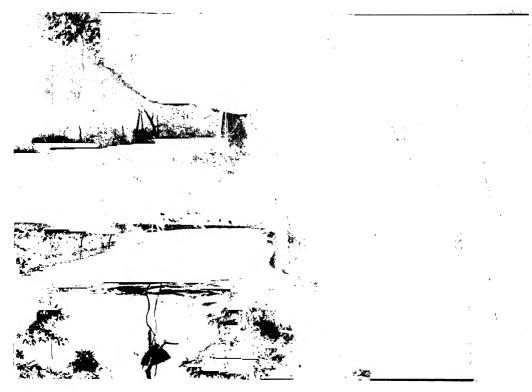
sion engineer of the Atlantic Division, I have had charge of the construction of the Gatun locks, the Gatun Dam, the breakwaters in Colon Harbor, and the excavation of the channel between the Gatun locks and the Atlantic Ocean.

If there are any people who yet hold the idea that the waters of the Atlantic

^{*}An address to the National Geographic Society, November 29, 1913



It is the Chagres River that has made the Panama Canal possible. It supplies the water for the Gatun Lake—the largest artif' all lake in the world—across which the vessels will steam for nearly two-thirds of the entire distart from coast to coast.



ON THE UPPER CHAGRES

This picture gives some idea of the many beauty spots found along the banks of the Chagres

and Pacific will mingle in this canal, I think that two statements of fact will dispel that idea forever.

One of the statements is that for about 32 miles this canal is 85 feet above the level of the Atlantic and Pacific. The second statement is that water will not flow uphill.

HOW THE CANAL IS DESIGNED

What has really been done is that a great dam has been built across the lower end of the valley of the Chagres, entirely blocking the flow of that river to the sea. The height of the dam and spillway is so fixed that the Chagres River will rise and rise until it reaches a stage 85 feet above the level of either ocean. At this stage the Chagres River will form a lake 165 square miles in area and 45 feet above the bottom of the cut that has been made through the Continental Divide at Culebra.

The Chagres, therefore, can flow into both oceans—to the Atlantic through the locks at Gatun and to the Pacific through the locks at Pedro Miguel and Miraflores. The water of the Gatun Lake not needed in passing ships through the locks goes to the Atlantic Ocean through a spillway (see page 170).

THE BREAKWATERS AT COLON

Starting at the Atlantic side, the first work that has been done is the construction of the west breakwater at Colon. It was thought that that breakwater would be sufficient to insure a safe harbor. The line of the canal at Colon is due north and south, and the most destructive storms, the "northers," are from a little west of north; so that the west breakwater will provide a safe anchorage for ships during such storms.

The prevailing winds at Colon, however, are the trade winds, that blow from the east or north and continue for more than nine months of the year. These winds do not produce a sea destructive to shipping, but they make a rough har-



One of the diversions very popular among the sporting members of the canal staff was alligator hunting. The upper waters of the Chagres could usually be relied upon to produce excellent sport, though these great reptiles are found in all the principal streams on the Isthmus

bor, stir up the soft bottom of Limon Bay and create currents, with the result that there is a large amount of silting in the channel through the bay. For two years in succession this silting amounted to more than two million cubic yards of material.

In order to remedy this condition, and for other reasons, it has been decided to construct an east breakwater also. Its, end will be opposite the end of the west breakwater, leaving an opening of 2,000 feet. When this breakwater is completed, the silting in the channel will cease and all difficulties of transfers from one boat to another in the harbor will be eliminated. The west breakwater should be completed in the summer of 1914, and the work on the east breakwater has just commenced.

HOW THE BREAKWATERS ARE BUILT

The method of building the breakwaters is as follows:

A trestle, suitable for a double-track railroad, was driven from the shore, extending for two miles out to sea. The rock forming the bottom of the breakwater was run out on cars and dumped or plowed off until the fill was made alongside the trestle to an elevation of 15 feet below sea-level (compare page 152). Between that level and 10 feet above sea-level the breakwater was built of hard trap rock, obtained from Porto Bello, the stone ranging in weight from 1,500 pounds to 15 tons.

The stone for the armor of the breakwater, as well as all crushed stone for the Gatun locks, came from this seacoast 'town of Porto Bello, situated some 20 miles northeast of Colon.

This place has given all kinds of trouble. The first year we attempted to crush stone for the Gatun locks, we had at Porto Bello a rainfall amounting to 237 inches—3 inches less than 20 feet; 9 feet of rainfall in two months; 58 inches in one month.

Everything happened at Porto Bello that could happen. Slides that no engineer would dream of occurring did occur. On an average 300,000 cubic yards of crushed stone every day were necessary for the concrete at Gatun. We had a young officer of engineers there, Captain

Stickle, who was doing the best he could, but we were pushing him anyway; so, after he had been urged and urged and then urged again to do more, one day he sent a wireless, "Fifty-eight inches of rain this month. Anything over fifty inches considered an act of God."

THE FRENCH CANAL WOULD HAVE BEEN USELESS NOW

A little to the north of the Gatun locks the American and French canals intersect, and the picture on page 158 shows the relative sizes of the two. Had the French canal been completed it would now be out of date, for its locks would not be of a size sufficient to pass the boats that would now offer.

In the French project the sea-level part of the canal on the Atlantic side extended about 10 miles farther. It the Chagres Valley than the American project. The water supply would have been materially less than in the American plan and would not have been sufficient for the substitution of locks of the size now built, and those now adopted are none too large to meet the requirements of Congress that the Panama Canal should be built of such size as reasonably to meet the demands of the future as to the size of ships.*

The canal is at sea-level from the Atlantic to Gatun; it then goes up a flight of three steps to Gatun Lake and continues at that level for 32 miles. Then down one step at Pedro Miguel to Miraflores Lake, which is 55 feet above sealevel; thence through the Miraflores locks, and the canal from there to the Pacific is at sea-level again.

The proudest day that Gatun has yet had was on the 26th day of September, 1913, when the little tugboat Gatun was lifted from sea-level to the surface of Gatun Lake, and was the first boat to pass through any lock of the Panama Canal (see page 162).

*The full length of each lock compartment is 1,000 feet. The largest ship in the world, the Vaterland, of the Hamburg-American Line, which is not yet completed, has a length of 950 feet. While it is unlikely that the huge liners used in the transatlantic passenger service will often be required to pass through the canal, still the locks are big enough to accommodate the largest ship in the world.



A COMPARISON OF THE FRENCH AND AMERICAN CANALS

This is a picture looking toward the Atlantic Ocean from the Gatun locks at the point where the present canal crosses the Frâch excavations. Had the French canal been completed, it would now be out of date, as it was much smaller than the present one and its locks (vould not be of a size sufficient to pass the large ships of the present day.

As soon as a boat passes the lower lock gates they are closed behind it, and water is let into that box or lock chamber from the lock above until the same level of water exists in the lower and middle locks, the boat being lifted 281/3 feet in this operation. After that the gate separating the lower and middle lock will be opened and the boat will pass into the second lock, the gates closed behind it, and the process repeated, the boat being lifted another 281/3 feet. That operation repeated once more will cause the boat to float out on the level of Gatun Lake.

The filling of the lower chamber of Gatun lock for the first time is shown in the picture on page 164. The gate on which all the men are standing is called the east gate or guard gate. These gates were completed as soon as practicable and then closed, so as to keep the sea out of the locks while dredges were completing the excavations in the lock entrance, thus not interfering with the work on the other gates nor with the machinery installation.

PAINTING MOSQUITOES

On both sides of the channel at Gatun were extensive swamps. They were great breeding places for mosquitoes, and in digging the channel through the soft, swampy bottom pipe-line dredges were used. These dredges cut up the material near the suction of the pumps, draw it in with water, and force it long distances through pipe-lines. In making the channel excavation those swamp areas were built up high enough to enable the sanitary department to drain them.

In 1912 Gatun had probably the greatest influx of malarial mosquitoes in its history; they came by the thousands. The Gatun Lake was rising at that time, and it was not known whether these mosquitoes were coming from that lake or not; so the sanitary department determined to locate all the breeding places for mosquitoes near Gatun, catch mosquitoes at each place, and after painting them turn them loose, and determine by the color of the mosquitoes caught in Gatun from what point they came.

It was found that the largest breeding

place was off to the west of the locks, in an old swamp that had given no trouble previously. A few mosquitoes had bred in this place all the time, but there were enough wild animals in the swamp to supply food, so the mosquitoes were not forced to migrate. When salt water was pumped into the swamp water, making the mixture about 30 per cent salt, mosquitoes began to breed by the trillions.

I went down there one morning to see how the mosquitoes were caught and painted. Walking along the edge of the water, mosquito bars were seen suspended from limbs tied up at the bottom. They had thousands of mosquitoes in them ready to be sprayed with a colored liquid, and the sanitary inspector was

asked how he caught them.

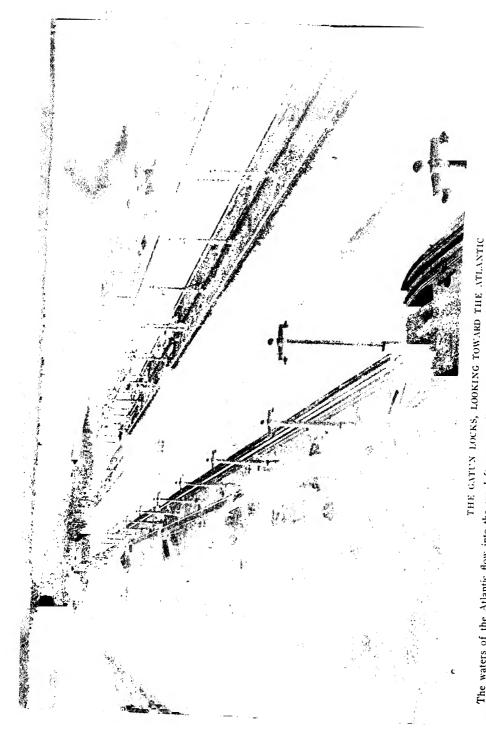
He said, "We have a more scientific way, but this had to be done in a hurry. We simply let the mosquito bar down, as you would over a bed, left one side of it open, and put a Jamaica negro in there for bait." As soon as the mosquito bar was full the bait was removed and the end tied up.

I saw some Jamaican negroes sitting out in front, and I said to one fellow. "John, were you the bait in that bar?" and he replied, "Yes, boss; that is the easiest money I ever earned—ten cents an hour for sitting there and doing nothing but just inviting the mosquitoes in."

THE DREDGING FLEET

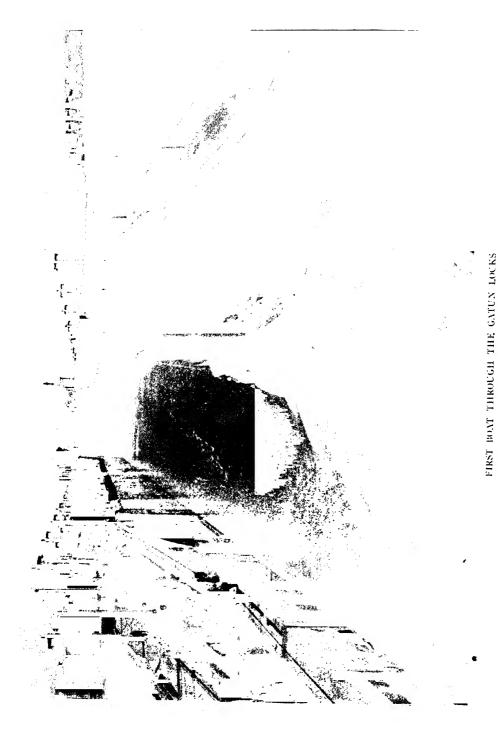
Just prior to the time that water was let into Culebra Cut, a fleet of dredges was brought up preparatory to removing Cucaracha slide, the last one that obstructed the passage across the continent. The picture on page 166 shows part of the fleet assembled for passing through the locks, and gives a good picture of a pipe-line dredge, showing the cutter in When this cutter is revolved. those blades loosen the dirt, the intake of the pump is just behind, and when the water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe.

The entire dredging fleet is shown in the picture on page 167. There were



The waters of the Atlantic flow into the canal for seven miles, until they reach the first gates of the lower lock at Gatun. The lower and left were a constant source of trouble while the locks were being made, owing to the innumerable mosquitoes which bred in them (see page 159).

THE LOCKS AT GATUN, LOOKING IN THE OPPOSITE DIRECTION TOWARD GATUN LAKE



One of the memorable days in the history of the Pahama Canal was September 26, 1913, when the tughoat Gatum was lifted from sea-level to the surface of Gatun Lake, being the first boat to pass through any lock on the canal

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about ten vessels of various sorts in one lock chamber, and even then it was not full. Attention is especially called to one piece of plant in the fleet, and that is the old French dredge, a ladder dredge distinguished by the endless chain with This old French dredge has buckets. served loyally two administrations and is still in the advance guard going to attack Cucaracha slide. By a peculiar coincidence, M. Bunau Varilla, the former chief engineer of the French Canal Company, passed through the locks during this event aboard one of the boats in the fleet. He, as you know, was a great advocate of a sea-level canal.

More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal. This fender chain across the entrance is shown in the picture on page 168.

THE FLOATING ISLANDS OF GATUN LAKE

A large part of the bed of what is now Gatun Lake was formerly swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose, the entire bottom floated. The wind broke it into pieces, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake (see page 172).

During the fall of 1912 the water was allowed to flow 6 or 7 feet deep over the uncompleted spillway, and a large number of these floating islands were passed over it. As soon as the lake reaches normal height and water can be spared, these floating islands will be towed systematically to the spillway and passed over and out to the Atlantic.

As the waters of the Chagres River came down and encountered the dam at Gatun the lake was gradually formed, and during this process much vegetation was submerged. As the lake rose it gave the ladies of Panama great opportunities for collecting orchids.

The most beautiful orchids have a way of growing on the largest trees, and so high that they are difficult to get; but while the lake was rising to 85 feet above sea-level, one could row around in small boats through the trees and pick them off (see pages 174 and 175). A Kipling should have been at Panama to write a jungle story that would describe the action of the wild animals when this great permanent flood of the Chagres came.

The last natural barrier that held back the water of Gatun Lake from the cut that had been made across the Continental Divide was the dike at Gamboa. Up to this point the canal has followed the Chagres Valley. It now leaves the valley and cuts across the Continental Divide to Pedro Miguel, and there commences to go down the Pacific slope.

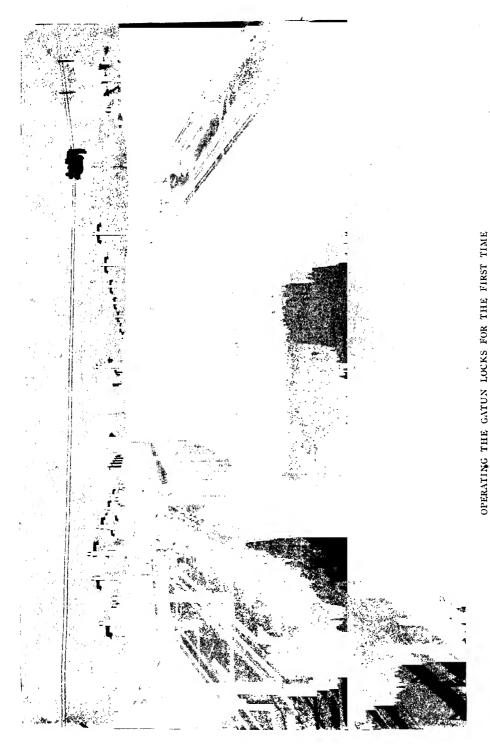
The Gamboa dike was broken down on October 10, 1913, by the explosion of a charge of dynamite which had been stored in it. This charge was fired by the depression of a telegraph key in the White House at Washington by President Wilson (see page 176). Before the dike was blown up, water was allowed to enter the Culebra Cut through pipes, so as to fill it to within 5 or 6 feet of the level of the lake. Had it been blown up with 30 feet difference in level, some damage might have resulted.

THE CULEBRA CUT AND THE SLIDES

The Culebra Cut will, it is thought, be the most striking of all the features of the canal. The Gatun Lake, when all the trees are gone, will be beautiful with its green islands and green promontories; but the most striking feature, I think, will always be the great cut across the Continental Divide.

The most difficult slides to handle have occurred in that part of the canal near the Continental Divide, marked by Gold Hill and Contractor's Hill, all comprised in a length of about 1½ miles of canal. Just beyond Gold Hill is the famous Cucaracha slide (see pages 147 and 151), the surface of which was above the lake level when the water entered Culebra Cut, and it prevented the water from flowing through the cut to Pedro Miguel.

An unsuccessful attempt was made on the same day that the dike at Gamboa



The gate on which all the men are standing, while watching the lower chamber of the lock being filled for the first time, is the sea gate or guard gate (see page 159)

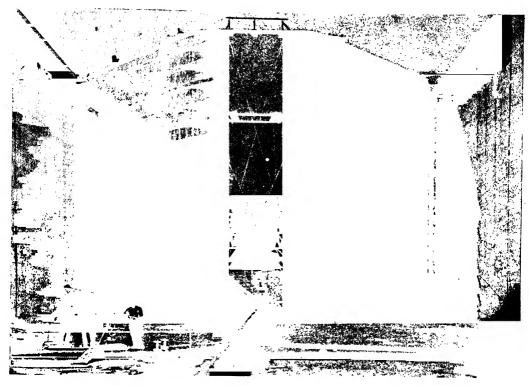


Photo and copyright by Edith H. Tracy

THE LOCK GATES

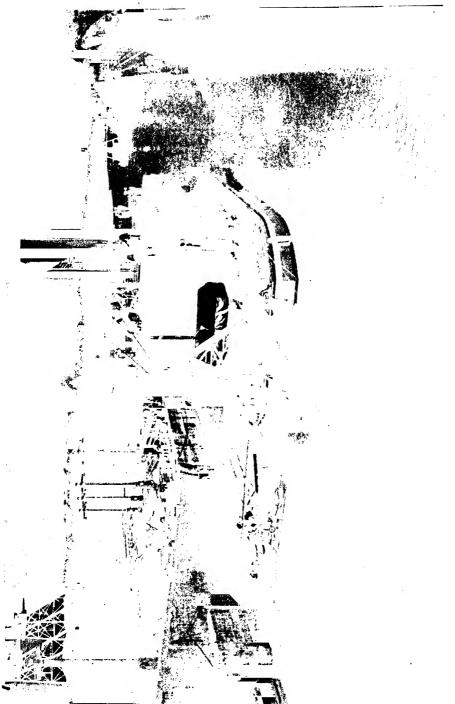
The lock gates are a most interesting feature of the canal. There are 46 of them, each having two leaves, and their total weight amounts to 58,000 tons. They vary in size from 47 to 82 feet in height and it takes no less than six million rivets to put them together. Some idea of their enormous size can be gained by comparing the men working on them with the gates themselves.

was destroyed to blast a channel through this slide. A ditch, however, was finally made across it, through which that part of the canal between Cucaracha and Pedro Miguel was filled with water. This allowed dredges to be towed from the Pacific end of the canal to assist those already brought from the Atlantic side in completing the channel excavations.

The Cucaracha slide has broken back to the crest of the hill behind Gold Hill, a half a mile or more from the prism. Since the slide is now broken back to the crest of the hill, and since the face of the hill away from the canal is being artificially removed, a fairly close calculation can now be made as to the number of cubic yards of material that can slide into the canal from that source and the approximate time that it will take to remove it.

A large part of the material composing this slide is clay, and it is hoped that it can be removed by pipe-line dredges. By placing a relay pump in the pipe-line, material can be forced over the banks of the canal. The pipe-line dredge is very efficient in digging and transporting material away from the site, providing the distance or lift is not too great. Material can be so transported from a half to three-quarters of a mile with great ease.

One of the dredges getting ready to attack the Cucaracha slide from the south is shown in the picture on page 148. This dredge came from the Pacific side, and across the slide can be seen the smokestack of the dredge that came from the Atlantic through the Gatun locks. It is hoped that within two or three months a channel can be made of sufficient width and depth for the passage of ships. How-



ONE OF THE GREAT SUCTION DREIGHS ENTERING GATUN LOCKS

This is one of the great suction or pipe-line dredges, showing the cutter in front. When this cutter is revolved the blades loosen the dirt; the intake of the pump is just behind it, and when water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe (see page 159).



DREDGING FLEET IN THE MIDDLE LOCK AT GATUN

The fleet is on its way to the Culebra Cut to help in removing the Cucaracha slide. The last dredge in the lock is an old French dredge of the ladder type, having an endless chain with buckets. This dredge has served loyally through two administrations and at the end was still in the advance guard. The immense size of the locks can be realized from the fact that there are ten vessels in this lock and yet it is not full,

"More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the upper lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal" (see text, page 163).

ever, no one who has served on the canal would try to make a definite prediction. A picture of this slide before the water was let in is shown on page 146.

Gold Hill is a hard trap rock, with a wolcanic neck extending down to an unknown depth, and is there to stay. On either side of it, however, the strata were very much disturbed and slides have occurred of all kinds of material, both clay and rock. The slides on the north side are nearly all of soft rock.

Colonel Gaillard, who had charge of the work in Culebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before. He struggled with the cut for six long years, until it was practically completed, but finally broke and died under the strain.

Two distinctive kinds of slides are encountered in Culebra Cut. In one case the entire body of material moves practically on an inclined plane, this plane being sometimes rock, sometimes clay. The Cucaracha slide is of this character and is called a true slide.

In slides of the other character, the first indication is a crack in the bank, sometimes 300 or 400 feet back from the edge of the cut. This crack or break opens, and the ground there will often settle down before it does at the edge of the cut. When the general movement comes, the bottom of the cut comes up. Steam shovels have been lifted by one of these slides as much as 18 feet, with the tracks hardly thrown out of alignment.

EARTHQUAKES AND THE CANAL

One of the great arguments against a lock canal at Panama was the earthquake argument, which prophesied that the locks would inevitably be destroyed by earthquake shocks. The picture shown on page 179 is the answer to that argument. It shows the famous flat arch in the now ruined church of Santo Domingo in Panama City, which has stood there for more than 200 years. The existence of this old and apparently unstable structure is a proof that Panama is free from serious earthquakes.

An examination of this arch, taken in connection with the fact that it has stood

for the length of time it has, seems to warrant the conclusion that Panama has been more free from serious earthquakes during the time in question than Tennessee, Missouri, or Arkansas, when it is remembered that Reel Foot Lake, in Tennessee, and the "Sunk Lands," in Missouri and Arkansas, along the basin of St. Francis, were formed during an earthquake in 1812, a little more than a century ago, while this structure has stood for more than twice that period.

Panama has been visited by a few earthquake tremors lately, one of them being of sufficient intensity to cause vases to fall from shelves, but careful examination of the locks failed to show the slightest cracks in the masonry, and the dam showed no tendency to settle or change its form in any way whatever. The center of the disturbances which produce the tremors is usually about 200 or 300 miles away. I do not know where the center of these last disturbances was, but when the serious earthquakes occurred in Costa Rica two or three years ago, only slight tremors were felt at Panama.

While I was away, in November, my wife wrote me that there had been another little earthquake since I left. She was upstairs and had a Jamaican woman sewing at the time, and just as the house commenced to shake the Jamaican woman fell down on her knees to pray. While my wife believes in the efficacy of prayer, she told the woman that the best place to pray during an earthquake was outside. The advice is thought to be good.

THE GATUN LOCKS

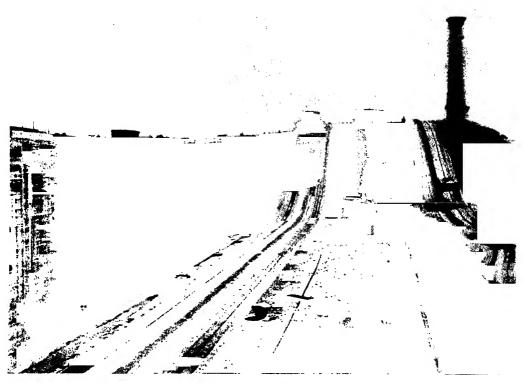
All the essential features of the Gatun locks are situated on rock. It is a soft rock and was called indurated clay in the first description of it; but people did not understand what indurated clay meant, and so the name was changed to argillaceous sandstone.

This stone is solid and makes a good foundation when not exposed to the air. If so exposed, however, it acts like shale and goes to pieces. In making an excavation for the locks and as soon as grade was reached, the foundation was immediately covered with concrete, thus re-



THE SAFETY VALVE FOR THE CHAGRES RIVER AND GATUN LAKE: THE GATUN SPILLWAY

top of which are 13 piers, which furnish it with 14 outlets. These outlets are closed by huge steel gates, 45 feet wide and 20 feet high, each weighing 42 tons. Should the Chagres River fill Gatun Lake so full of water as to endanger the locks at Gatun, this spillway would act as the safety valve. Even if the lake rose to the improbable height of 92 feet above sca-level—its normal height is 85 feet—it would not be necessary to open all the gates on the spillway. Three or four of them would carry off all the water necessary to avert danger. The surplus waters of the Gatun Lake escape to the Atlantic Ocean-through this spillway. It is a large semicircular concrete dam, along the



THE LOCOMOTIVES OF THE LOCK

These little electric locomotives, here shown climbing the incline between the middle and upper locks at Gatun, are very powerful and will be used to draw the big ships through the locks. No ship will be allowed to go through the locks under its own steam (see page 173). Note the men at work on the huge lock gates.

producing the same condition under which nature has kept the rock sound.

There can be no question as to excellence of the foundation of the locks at Gatun. They are completed and have been subjected to the most trying conditions without the slightest settlement or crack. As stated before, all the essential parts are on rocks; the only exception is the south guide wall, the one that leads into Gatun Lake. This is built on piles and is of as light construction as possible. It has no particular function except that ships will land on both sides of it.

Prior to the construction of the Gatun locks, many holes were made with a diamond-drill outfit into the rock foundation to depths of 100 feet or more below sea-level in order to ascertain the character of the foundation and determine whether or not the rock was sufficiently creviced to transmit pressure from the

lake to the lock floor. After the holes were bored the ground water showed in them. By pumping the water out of some of the holes and observing to what extent and how quickly the water was lowered in the others, conclusions were drawn as to the probability of the rock being sufficiently creviced to transmit pressure.

These experiments indicated that minute crevices were in the rock, not enough for the passage of any appreciable amount of water, but probably enough to transmit pressure. Consequently the floors in the Gatun locks from the emergency dams to the intermediate gates of the upper locks are so built that if the full lake pressure does come under them they will stand it. Below that, provision is made for carrying any leakage to sea-level through drains behind the lock walls.



A large part of Gatun Lake bed was swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose, the entire bottom floated. The wind broke it into piec s, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake.

In case a ship should break the upper lock gates and the Gatun Lake should start to flow through the flight of locks to the sea, a swing bridge is provided for each upper lock, by means of which an emergency dam can be built across the The operation of these swinglocks. bridge dams is as follows: The bridge is first swung across the lock chamber and heavy girders are then lowered, one end of each of them finally resting against a sill previously built in the bottom of the lock entrance. Steel curtains are then run down in tiers on tracks on the girders, gradually building a dam and stopping the flow of water. The girders and curtains are all lowered under power and the entire operation can be carried on through swiftly flowing water.

It is purposed to allow no ship to go through the locks of the Panama Canal under its own steam. A ship will be required to land alongside the guide wall

at either end of the locks.

Towing locomotives, four of them, will run down the guide walls, pass lines to the ship, two forward and two aft, and will then tow the ship into the locks, hold it during the time it is being raised or lowered, and finally deliver it alongside the guide wall at the other end. This is a precaution that has never been taken before in operating locks. One of the experimental towing locomotives is shown in the picture on page 171.

Ships are ordinarily allowed to pass through locks under their own steam. The wrong ringing of a bell or the misunderstanding of a bell has ordinarily been the cause of wrecking a lock gate.

HIGH AND DRY BELOW SEA-LEVEL

One of the most difficult problems at Gatun was the preparation of a foundation at the lower end of the locks. It was necessary to go 70 feet below sea-level through soft mud to find rock suitable for foundations. The material was so soft that steam shovels could not be supported on it, so it was decided to do the excavation by dredges. A sufficient width of land between the space to be excavated and the canal toward the Atlantic was left to act as a dam when the excavation was finally completed and unwatered.

A dredge was allowed to cut a narrow channel through this dam into the space where the walls were to be built. This dredge dug the entire space to a depth 40 feet below sea-level, which was its limit. A dam was then placed across the narrow entrance cut, with the result that the dredge lowered itself as it continued its work. When it had lowered itself to 30 feet below sea-level, it could excavate to the required depth—70 feet below sea-level.

After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out (see page 179).

THE GREAT GATUN DAM

Gatun dam, across the Chagres Valley, is about a mile and a half long, a third of a mile thick at the base, with a top elevation of 105 feet above sea-level. A small hill existed in the center of the valley at the clam site. While it was 200 feet below sea-level to rock in the portion of the valley to the east of the central hill and 260 feet to rock in that portion to the west, rock was found at 40 feet above sea-level in the central hill itselfa fortunate condition, because a stable channel for the temporary diversion of the Chagres could be easily cut through this hill, across which channel a masonry spillway, founded on rock, could be built later.

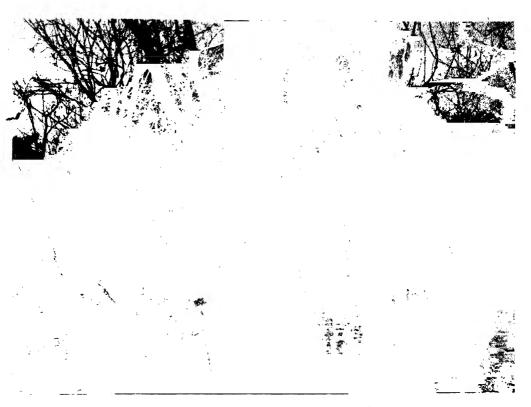
A spillway through an earthen dam is generally looked upon with disfavor. While the Gatun Dam is earthen, it is really two dams, one extending from the locks to this central hill and one from this central hill to the west side of the valley. Rock existing at a high elevation in this central hill made it an ideal location for a spillway or waste weir.

When the building of the Gatun Dam was commenced, the Chagres River was flowing through three channels at the dam site—its own, the old French canal, and a diversion channel dug by the French to the west of Spillway Hill. The first operation was to block the flow of



THE DYING JUNCLE IN GATUN LAKE

in small boats through "As this lake rose it gave the ladies great opportunities for collecting orchids. The most beautiful orchids have a wey of growing largest trees and so high that they are difficult to get, but as the lake rose to 85 feet above sea-level, one could row around in small boats the trees and pick them off" (see text, page 163). When this photograph was taken the water had only risen to 52½ feet apove sea-level.



THE DROWNING TREES IN GATUN LAKE

When this picture was taken there was only 521/2 feet of water in Gatun Lake, but when the lake is full these trees will be entirely submerged

the Chagres through its own channel and Through the old French canal, thus forcing all the water through the west diversion channel.

This enabled the work of building the east half of the dam to be started while a channel was being dug through the Spillway Hill. As soon as this latter channel was finished the Chagres River was turned into it by damming the west diversion channel.

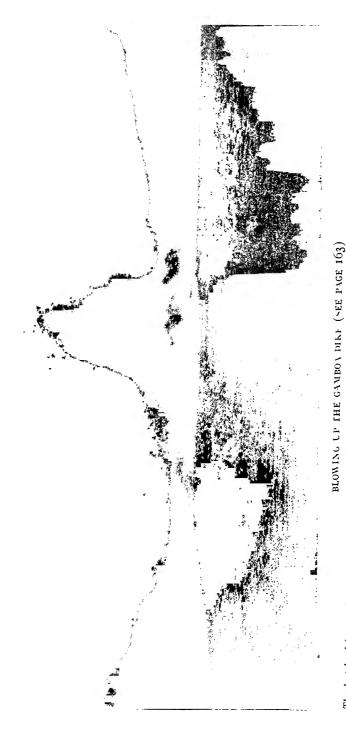
The bed of the west diversion channel being below sea-level, with soft banks and bottom, and the bottom of the Spillway channel being 10 feet above sealevel, this last diversion of the Chagres proved to be a troublesome undertaking. As soon as this last diversion was accomplished work on the west half of the dam was commenced.

The watertightness of the Gatun Dam was never a subject of serious apprehension. The material under it and that in

the center of it are practically impermeable. The great problem concerning the Gatun Dam has been to make the material on which it was built carry the load.

I referred to the rock being 200 feet below sea-level on one side of Spillway Ilill and 260 feet on the other. These old gorges, so the geologists say, were made by the Chagres River when all the country in the vicinity of Gatun was about 300 feet higher than it is now. When the site of the Gatun Dam was lowered 300 feet during some early volcanic disturbance and its old beds lowered 200 feet below sea-level, the sea backed up the Chagres Valley and in time filled these old gorges with deposits, largely of clay, which in some places were soft. In order to make such a foundation carry a heavy load, an exceedingly broad base was necessary.

Dams are ordinarily built with quite steep slopes, one in two, or one in three,



The last land barrier between the two oceans was broken down on October 10 1913 by the explosion of a charge of dynamic stored in the Gamboa Dike. The charge was fired by the depression of a telegraph ke, at the White House by President Wilson.

whereas the Gatun Dam was built with a slope of about one in ten. The foundation was simply spread, making the dam about a third of a mile through at the base, so that the underlying material would carry the load. This underlying material was compressed under the load in some places as much as 15 feet. As the load was gradually placed on it, the material in the base became more and more compact, until finally settlement has practically ceased.

Every two or three months borings have been made through the material in the dam itself, and that under it, for the purpose of ascertaining any changes in the character of such materials. This data shows that the material, both in the dam and under it, is continually becoming more compact. It stands today, safely carrying its full load, and tomorrow it will be able to carry more.

THE JAMAICAN IS HARD TO KILL

The dam was built by constructing trestles in both edges of it and from these trestles making rock fills or "toes." When these toes had reached a height of 60 feet on the south face and about 30 feet on the north, dredges commenced to pump an impermeable mixture of sand and clay in between them. This central core constitutes the real barrier to the passage of water through the Gatun Dam

As the hydraulic fill was built up the rock fills were carried up, so as always to constitute levees, holding the additional hydraulic fill. A pipe-line dredge pumps about 20 per cent solid material and 80 per cent water, so in building a dam in this way it is necessary to provide some means for draining off the surplus water.

This was done where the dam joins the hill, a 20-inch pipe being laid in a trench on the rock and carried in to the lower edge of the hydraulic fill. An elbow was then placed on the end of the pipe, and as the water and hydraulic fill rose other sections were added to the elbow. A cage was placed around the intake end of this pipe to keep the drift away, and men were sent occasionally to remove such drift from the pipe intake.

At one time when water was running

through this pipe under a 30-foot head, three Jamaicans were removing drift and one of them fell in the 20-inch pipe. The other two tried to pull him out but could not. They let him go and ran as quickly as they could to the other end of the pipe. The man traveling in the pipe reached the end first, notwithstanding the fact that he turned a corner at an angle of 90 degrees. His ears were scratched a little!

There was a great deal of emulation between the employees in the different divisions. The part of the story so far told is true, but Colonel Gorgas made the addition that the man jumped up and said that there wasn't anybody on the Pacific Division who could do that.

The spillway over which the surplus waters of the Gatun Lake find their way to the Atlantic Ocean is found on page 170. This is a picture of the spillway when practically complete.

The gates on top are 45 feet wide and the lake will stand 16 feet deep against them when no water is being wasted; consequently if one or more of the gates is lifted water will flow between the piers 16 feet deep. These gates are raised and lowered like a window-sash. These movable gates constitute the regulating works, by means of which the level of Gatun Lake is controlled.

"THE QUEEN OF AMERICA" AND THE LUNCHEON PARTY

In the beginning but very little provision was made for quarters for families of the canal employees. It soon became evident that order could not be maintained, contentment prevail, and a permanent force kept unless the wives of the men were there; so the commission undertook to build family quarters.

It was announced in circulars, etc., that employees would be provided with family quarters within ten months after arrival on the Isthmus. Not only all the married men immediately applied for quarters, but nearly every unmarried man on the job applied. Family quarters carried with it free light and fuel.

Nearly every one of the young unmarried men the first time they came back from leave brought a wife if they could get one. The building department was



The lock-chambers here and at Pedro Miguel art the same size as those at Gatun. At this lock, the last on the Pacific side, boats can be let tion of the Culebra Cut. The boat shown in the pictur is entering the lock from the Pacific Niguel locks at the termina-

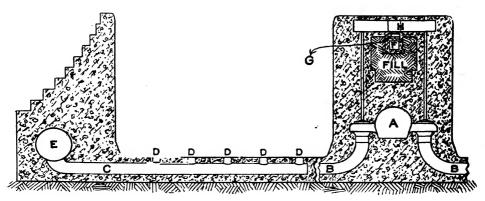


DREDGE GROUNDED 55 FEET BELOW SEA-LEVEL (SEE PAGE 173)

This dredge was used to excavate the foundations of the Gatun lock and dug down 70 feet below sea-level. "After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out."



The water enters through a series of apertures arranged in rows of five along the floor of the lock. The barrel-shaped objects on the right of the picture are jets of water which have not burst into spray like those on the left (see page 181)



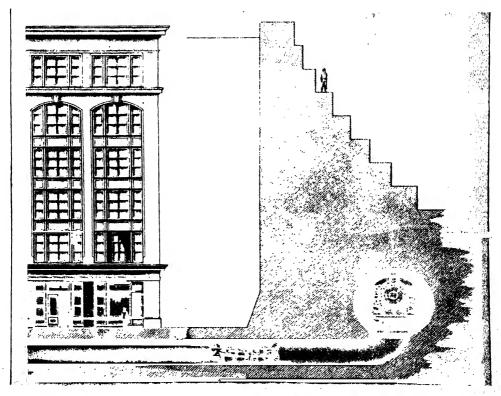
A CROSS-SECTION OF A LOCK CHAMBER AND WALLS, GATUN LOCKS, SHOWING HOW THE LOCKS ARE FILLED AND EMPTIED

E. Culvert in side wall.

A. Culvert in center wall.
B. Connections between center and lateral

culvert.

F. Drainage gallery.
G. Gallery for electric wires.
H. Passageway for operators. C. Lateral culvert. D. Wells opening from lateral culverts into lock chamber.



THE SIDE WALL OF ONE OF THE GATUN LOCKS COMPARED TO A SIX-STORY BUILDING The size of the culverts may be appreciated from the engine and dray. The "steps" have been filled in with earth and stone and graded to the top



THE FLAT ARCH AT PANAMA

One argument against the construction of a lock canal was that the great locks at Panama might be destroyed by earthquakes. This flat arch, which any serious earthquake shock would destroy, has stood for nearly three centuries in the now ruined church of Santo Domingo at Panama, proving that fear of earthquakes is groundless (see page 169).

consequently overwhelmed and the commission was forced to withdraw its literature and make no promises. An attempt was made after that to provide a certain percentage of the employees with family quarters.

The greater part of the laborers on the canal were Jamaican negroes. They were British subjects, but were ordinarily called "British objects." They make good servants if thoroughly trained and the routine is not varied.

To illustrate the effect of varying the routine: Visitors often came rather unexpectedly for lunch at Gatun, and in order that things might go right if my wife happened to be away when company came, she had prepared menus for lunches—number 1, number 2, number 3, etc. All I had to do was to telephone the cook that so many people were coming and to prepare lunch number so and so.

One day Mrs. Roosevelt and her daugh- ter came with Mr. Bishop to see the work at Gatun, and after asking them to lunch, my wife being away, I telephoned the cook that there would be three extra people and to prepare luncheon number 1. I, unfortunately, said that Mrs. Roosevelt would be there.

The Jamaican has great respect for royalty. Before reaching home I heard that our servants had passed the word around among the other servants at Gatun that the Queen of America would take lunch at our house today. On entering the house it was evident that every piece of cut glass, silver, or pretty China in the place was out where it could be most easily seen.

On reaching the table it was soon been that we had lunches 1, 2, and 3 combined. But finally, when four tiny cups of coffee were passed on a large salver resurrected from an old chest upstairs, the ridiculous side of the situation was complete.

Now that the canal is essentially finished, what are the American people going to do with it? Shall the new markets brought into existence on the Pacific shores of Central and South America by this new cheap transportation route be

supplied by the United States or by foreign countries?

In my judgment, that depends, more than anything els3, upon whether the Congress of the United States enacts such laws as will bring into existence a United States merchant marine engaged in foreign commerce.

THE NATION'S UNDEVELOPED RESOURCES

By Franklin K. Lane

SECRETARY OF THE INTERIOR

The following article gives such a constructive and national presentation and discussion of our country's undeveloped resources that it should be read by every American. It forms the annual report to the President of the United States by Mr. Lane, Secretary of the Interior, and is here published in full. For a map of Alaska, see the Supplement to this number of the National Geographic Magazine.

HERE exists a feeling in the West that its affairs and needs have not been given that consideration at the hands of the national government which they merit. This feeling is not confined to speculators or exploiters. It is the sentiment of many who are without selfish motive and regard the matter wholly from the standpoint of national growth. They point to the conditions which obtain in Alaska as unparalleled among people of our aggressive and nation-building stock.

So, too, they are unable to understand why ways have not been found by which the great bodies of coal and oil lands, of phosphate and potash lands, may be developed, and the waters of the mountains made available for the generation of power and the redemption of the desert.

There is one very simple explanation for the existence of this feeling. We have adventured upon a new policy of administering our affairs and have not developed adequate machinery. We have called a halt on methods of spoliation which existed, to the great benefit of many but we have failed to substitute methods, sane, healthful, and progressive, by which the normal enterprise of an ambitious people can make full use of their own resources. We abruptly closed op-

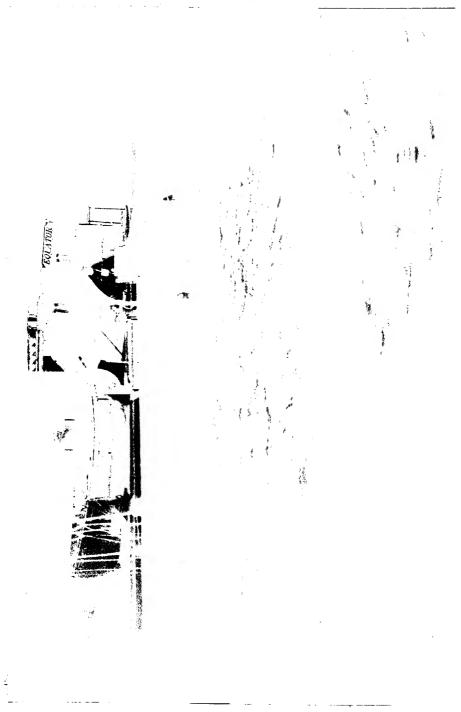
portunities to the monopolist, but did not open them to the developer.

FORMERLY WE TRIED TO GET RID OF OUR LAND AS QUICKLY AS POSSIBLE

I have said that we had put into force a new land policy, which caused dismay and discontent. Let me explain what I mean by this. It was, in fact, but a new application of an old policy. Congress has always been most generous as to the disposition of the national lands. One cannot read our land laws without being struck with the fixed determination which they show that it was wisest to be quit of our lands as quickly as possible. It might almost be said that the government regarded its lands as a burden rather than an asset. We gave generously to our railroads and to the States. There was land for all, and it was the government's glad function to distribute it and let those profit who could.

There was no thought then of creating timber barons or cattle kings, or of coal monopoly. The sooner the land got into hands other than those of the government the better.

And this generous donor was not so petty as to discriminate between kinds of lands, the uses to which they could be put, or the purposes which those might



CARCOES OF SALMON ARRIVING AT AN ALASKAN CANNERY

"The purchase of Alaska was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern, yet its mines, fisheries, and furs alone have added to our wealth the grand sum of \$500,000,000" (see text, page 185).

have who got them. Land is land, save when it contains minerals; this was roughly the broad principle adopted. To classify was a task too difficult or not worth while. The lands would classify themselves when they arrived in individual ownership. And so the door was opened for monopoly and for fraud.

If the government did not appreciate the invaluable nature of its assets, there were men who did. Great fortunes were laid in the vast holdings of what had but a short time since been the property of the people. There was danger that the many still to pour into the West would by necessity become the servitors of a fortunate and early few. On this discovery our indifference at once took flight. And so out of the abuse of the nation's generosity there came a reaction against a policy that was so liberal as to be dangerous.

The nation wanted home-makers, but found its lands drifting into the hands of corporations which were withdrawing them from the market, awaiting a time when lands would be more scarce; it gave opportunity for many competing coal operators and iron manufacturers, but found the sources of raw material centering into a few large holdings; it wished its lands to be cleared of forests to make way for farms, but it found hundreds of consecutive miles reserved from use by the fiat of those who appreciated their worth, and many more miles of watershed despoiled of its needed covering in places where homes were not possible.

A REACTION WAS INEVITABLE

A reaction was inevitable. If lands were to be withdrawn from public service, why might not the government do the withdrawing itself? The old philosophy that "land is land" was evidently unfitted to a country where land is sometimes timber and sometimes coal; indeed, where land may mean water—water for tens of thousands of needy neighboring acres; for the lands of the West differ as men do, in character and condition and degree of usefulness. We had not recognized this fact when we said "land is land." Lands fitted for dry farming and lands that must forever lie unused without irri-

gation; lands that are worthless save for their timber; lands that are rich in grasses and lands that are poor in grasses; lands underlain with the non-precious minerals essential to industry or agriculture; lands that are invaluable for reservoir or dam sites—these varieties may be multiplied, and each new variety emphasizes the fact that each kind of land has its own future and affords its own opportunity for contributing to the nation's wealth.

So there has slowly evolved in the public mind the conception of a new policy that land should be used for that purpose to which it is best fitted, and it should be disposed of by the government with respect to that use. To this policy I believe The West the West is now reconciled. no longer urges a return to the hazards of the "land is land" policy, but it does ask action. It is reconciled to the government making all proper safeguards against monopoly and against the subversion of the spirit of all our land laws, which is in essence that all suitable lands shall go into homes, and all other lands shall be developed for that purpose which shall make them of greatest service; but it asks that the machinery be promptly established in the law by which the lands may be used; and this demand is reason-

ALASKA HAS ENORMOUS UNDEVELOPED RESOURCES

The largest body of unused and neglected land in the United States is Alaska. It is now nearly half a century since we purchased this territory, and it contains today less than 40,000 white inhabitants, less than 1,000 for each year it has been in our possession. The purchase was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern; yet its mines, fisheries, and furs alone have added to our wealth the grand sum of \$500,000,000.

For almost a generation it was the rich harvest field of a single company. Individual fortunes have been made in that country larger than the price paid to Russia for the whole territory. How rich its waters are we know, because they have been proved; but how rich its lands are in gold and copper, coal and oil, iron and zinc, no one knows. The prospector has gone far enough, however, to tell us that no other section of our land today makes so rich a mineral promise.

And in agriculture the government it-self has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally.

This vast and unsurpassed asset lies almost undeveloped. A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a few inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked.

The one constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the benefit of the Eskimo on the border of the Arctic Ocean. For the white man we have done nothing—so little, in fact, that to mention what we have done is matter for chagrin and humiliation. I have thought that perhaps the scandals that have developed in Alaska have been in some part the result of a feeling that it was a No Man's Land, where the primal instincts and powers were the only law.

SOUTHEASTERN ALASKA HAS A MORE EQUABLE CLIMATE THAN WASHINGTON, D. C.

This unfortunate condition cannot be explained on the ground of the inhospitality of the Alaskan climate. A careful study of isothermal lines shows that some

of southeastern Alaska has a climate more temperate and more equable than that of Washington, D. C., while much of the greater portion to the north has a kindlier climate than Stockholm or St. Petersburg. Moreover, our people are not stayed in their quest for homes or wealth by the rigors of a long winter. The spirit and purpose which brought them from Europe to Virginia and to Massachusetts take them today to Montana and Saskatchewan. The United States lately opened to entry a tract of land in Montana for which there were 46,000 applicants for registration, and only 7,000 of these could be given an opportunity to homestead. There is more railroad building 500 miles north of the Canadian border than there is for the same distance south of it.

. Why has not this land been developed? The frank answer is that we did not realize until within a few years that it was worth developing. As soon as we discovered its value as a national asset we became alarmed and drew back, affrighted at the thought that we might lose it, or at least that it would become the property of those who would exploit it without respect to the public interest. Since then we have been waiting to make up our minds as to what wisely could be done. We have hesitated and halted out of the very keenness of our appreciation of what Alaska might become.

It has rather been in compliment to Alaska than in derogation of her value that we have done so little for her in late years. It was a new land, to be opened under new conditions. The mistakes made there and here we did not wish to repeat. But now, after a long pause, it would seem to be the sense of the people that we shall proceed at once and in a large way to deal with the problem of Alaskan development.

PROPOSED ADMINISTRATIVE BOARD

We have withdrawn Alaska from the too aggressive and self-serving exploiter. What have we to substitute as a safer servant of public interest? To this question I have given much thought, and my conclusion is that if we are to ring Alaska into the early and full realization



A PILE OF GOLD IN THE ASSAY OFFICE AT NOME, ALASKA

"Individual fortunes have been made in that country larger than the price paid to Russia for the whole territory" (see text, page 185)

of her possibilities we must create a new piece of governmental machinery for the purpose. We should undertake the work in the spirit and after the method of a great corporation wishing to develop a large territory.

In my judgment, the way to deal with the problem of Alaskan resources is to establish a board of directors to have this work in charge. Into the hands of this board or commission I would give all the national assets in that territory, to be used primarily for her improvement—her lands, fisheries, Indians, Eskimos, seals, forests, mines, waterways, railroads—all that the nation owns, cares for, ontrols, or regulates. Congress should determine in broad outline the policies which this board in a liberal discretion should elaborate and administer, much as is done as to the Philippines.

This board would, of course, have nothing whatsoever to do with the internal affairs of the organized Territory of Alaska, for it would exercise no powers save such as Congress granted over the property of the United States in Alaska.

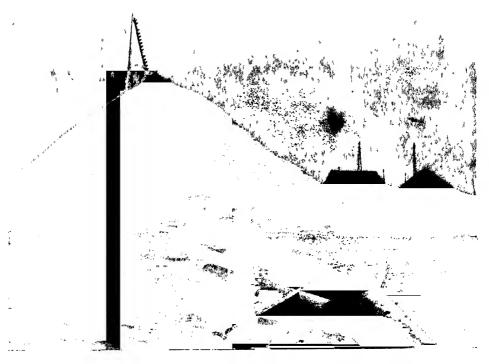
THE BLACK BEAR IS CARED FOR BY ONE DEPARTMENT AND THE BROWN
BEAR BY ANOTHER

There are several reasons which appeal to me as supporting this suggestion:

- 1: Such a board could advise Congress as to what should be done, without prejudice, out of a deep national interest and with first-hand knowledge of conditions.
- 2. Such a board would coördinate the present enterprises of the government in Alaska. As it is now, the control of lands is in one department, of forests in another, of roads in another, of fisheries



D. ing the summer, or rather as soon as water can be used without any danger of its freezing these great piles of gravel are carefully washed by the summers and the gold extracted (see picture on page 189) A MANTER SCENE AT NONE, SHOWING GREAT PILES OF GRIVEL WHICH ARE HEALD UP DURING THE WINTER BY THE MINERS



GLITING THE GOLD OUT OF THE GRAVEL IN SUMMER: NOME

m a fourth, of railroads in still another. The care of black bear 15 in one department and brown bear in another

3. There can be no satisfactory administration of land laws nor any other laws at a distance of 5,000 miles from the point of action. Much less is this possible where the two sections of the country are separated by an ocean, and the land calling for attention is closed to the world one-half of the year. The eye that sees the need should be near the voice that gives the order.

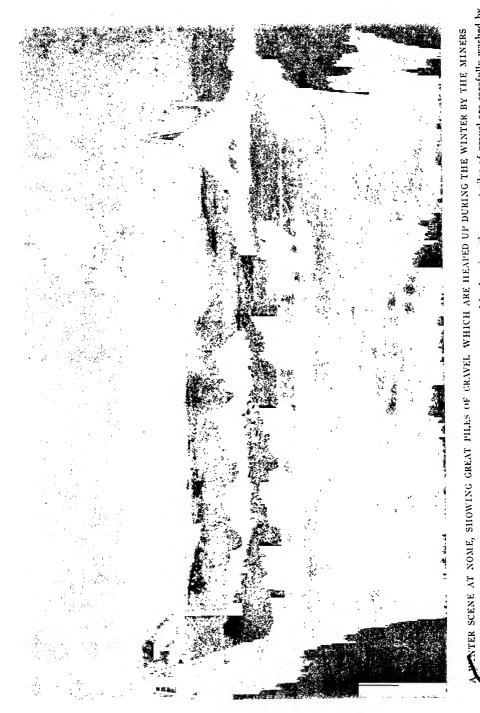
4 Alaska's opening and improvement should be treated as one problem. Each step in such an administration should be part of a plan, not an isolated act. We should have a unified and consecutive program, based on immediate knowledge governing this work. Each line of activity within the Territory should be correlated with all other activities. The opening of lands and the building of railroads or wagon roads, for instance, should be part of one scheme.

5 Alaska should be developed so far

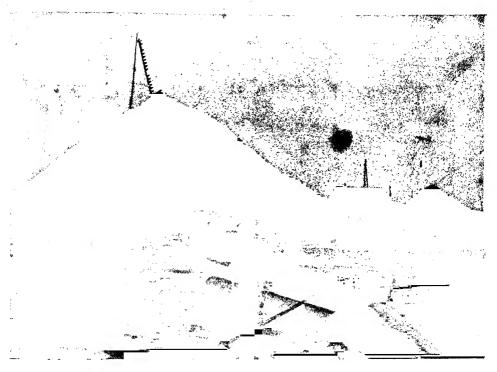
as possible out of her own revenues and resources She should have a Federal budget of her own Her revenues and expenditures should be presented to Congress on a single sheet. The funds raised from her lands and fisheries, her furs, her forests, and her mines should be used for the construction of her roads, railroads, telegraph and telephone lines, or for any other purpose which would make her resources more quickly available to the world.

ALASKA IS ALREADY SELF-SUPPORTING

I believe it could be shown that Alaska is self-supporting today, or, what is more to the point, that by proper taxes and charges imposed upon those who are deriving large return from their enterprise in the Territory, such revenue could be derived as would support a large policy of expansion and improvement. In short, I would construct the administrative machinery that would most surely lead to a prompt and continuous development of Alaska as a part of the United States



Disting the summer, or rather as soon as water can be used without any danger of its freezing, these great piles of gravel are carefully washed by the summers and the gold extracted (see picture on page 189)



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The gold placer fields of interior and northwestern Alaska no longer give employment to as many men as in former years. Decause of the adoption of new methods of mining. The gold output is still large, the amount produced in 1912 being valued at more than \$17,000,000.

upon a plane commensurate with her possibilities industrially, agriculturally, and socially.

The members of such a board appointed by the President would be selected presumably with reference to their fitness for the work to be done. Each one could be made the administrative and residentiary head of a department or division, so that there might be a commissioner of the Alaskan land office, another commissioner of highways, another, perhaps, commissioner of Indian affairs and fisheries, and so on. All would sit together, as in the commission form of municipal government, and would work for a common end, the upbuilding of Alaska as an integral and contributing part of the Union.

I apprehend the fear that with such a commission there would be danger of corruption or indifference creeping into its work. This, however, is incident to the bestowal of all authority. The commission would not go unchecked, of course, for it must report to the head of some department at Washington, and through that head to Congress, and would be always subject to investigation. Moreover, no method has yet been invented by which dishonesty or poor judgment can be guarded against in public or in private life. In the end the character and wisdom of the men appointed is the only insurance that can be given against conduct that is foolish or worse.

Alaska should not, in my judgment, be regarded as a mere storehouse of resources upon which the people of the States may draw. She has the potentialities of a State. And whatever policy may be adopted should look toward an Alaska of homes, of industries, and of an extended commerce.

WHAT SHOULD BE DONE AT ONCE

Strongly as I would urge this method of management—for it offers a rare opportunity to exhibit the efficiency of a republic—I would not have Alaska wait for needed legislation until the merits of such applan could be passed upon by Congress. Those things which appeal to me as of immediate necessity upon which independent action may be taken are (1)

the construction of railroads in the Territory and (2) the opening of her coal lands.

I have already expressed to Congress my belief that it was wise for the government itself to undertake the construction and operation of a system of trunk-line railroads in Alaska. And I am led to this view irrespective of the possibility of private enterprise undertaking such work, although my belief is that no railroads would be privately constructed in Alaska for many years to come excepting as adjuncts to some private enterprise. Be that as it may, it would seem wise for the government to undertake this task upon grounds of state.

The rates and the service of such railroads should be fixed with reference to Alaskan development—not with regard to immediate returns. The charges fixed should be lower for years to come than would justify private investment.

I would build and operate these highways in the same spirit that the counties or the States build wagon roads—not for revenue, but for the general good. After all, a railroad is little more than an operated wagon road. In many countries they still call railroad cars "wagons." Our laws as to railroads are evolved from our old laws as to carriage by Our courts speak of railroads as property charged with a public interest and so justify the regulation of their rates. But no court would justify the imposition of rates made for the purpose for which Alaskan rates should be made—the creation of a Commonwealth. If this is our task, it should be done whole-heartedly and with a consciousness that the dollar spent today on an Alaskan railroad will yield no more immediate return on the investment than the dollar spent on the Panama Canal.

WHY THE GOVERNMENT SHOULD BUILD THE ALASKAN RAILROADS

These, then, are the persuading reasons for the belief that the government should undertake to drive from the coast inland one or more lines of railroad: (1) The government already regards it as its duty to build wagon roads. Such roads when well built are almost as costly as



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the construction of a railroad, which is the essential modern means of transportation. (2) There can be no assurance that without surrendering our resources in Alaska private railroads will be built. (3) The opening of this new country demands that the highways of travel and commerce should be made wholly subservient not to private interest, but to the upbuilding of this territory, that they may be the real servants of the national purpose.

If it is thought wise to recoup the government for its original outlay, it can be done, at least in part, by following a plan not unknown to our people-by giving a land subsidy to the owners of the road. Retain in the government onehalf of the land on each side of the railroad until it has appreciated in value by the growth of the lands given to the Thus the government would subpublic. sidize itself and reap some of the benefits accruing to its land from the construction of the road. Judging by the increase in land values in the newly opened sections of Canada, who could say but that long before the bonds were due the government would thus have an asset sufficient to meet the original debt?

There seems to me no necessity for barring the way to minor privately owned roads because of the presence of longer systems of publicly owned roads. The two exist together in other countries. I would not even apply the principle of the commodities clause of the act to regulate commerce to such roads. They should be built, however, under governmental supervision, capitalized and operated under the strictest regulation, and be at any time subject to purchase by the government at their cost, minus depreciation.

THE VALUE OF ALASKAN COAL

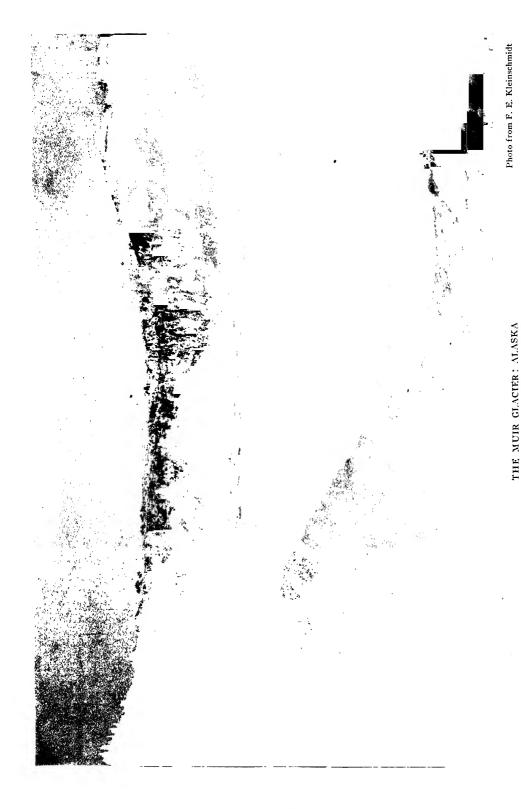
It is not necessary to set forth here the extent or character of the coal fields of Alaska. Neither could I add to your knowledge or that of Congress as to the need for this coal both by the navy and by the industries and the people of the Pacific coast generally. There are almost unlighted quantities of a high grade of lighte in the interior which may not stand extended storage or transportation.

This could be converted into electricity at the mouth of the mines and widely distributed for lighting, heat, and power. Toward the southern coast of the peninsula there are two well-known fields of a high-grade bituminous coal and some anthracite. These are the fields which have given rise to the troubles with which all are familiar.

* These coal fields should be opened not to speculators, but to operators. Those should have these lands who will use them. None should be opened as a basis for a gamble in future values. If these premises express a sound public policy, there appears to me but one conclusion that can be reached as to the manner in which they may safely be turned over to the public—under a leasing and royalty system similar to that under which the State of Minnesota leases its ore lands and the States of Montana and Colorado their coal lands.

The tracts opened should be disposed of to those who within a certain time would develop mines and make their product commercially available. This means that where a railroad is necessary to the operation of a mine the applicant should take a lease so conditioned for a limited period. Sufficient land should be leased as a body to justify long-continued and economical operation. As the average of all operations in the United States is 2,600 acres, including many small holdings, this might be taken as a maximum unit.

There has been much dispute between those who favor making a lease for an indeterminate period, dependent alone upon continued operation, and those who believe it wisest to fix a term for the lease, 20, 30, or more years. This dispute seems to me of much more academic than practical interest. There should be no disposition to change the lessee. If a fixed term of lease is decided upon, the original lease should have an assured preferential right to a renewal until the mine is worked out. So that in the end the fixed term is a reservation of the right on the part of the government to make new terms at the end of a number of years, a reservation which could be fixed in an indeterminate lease.



This glacier, which is the largest in the world, has a frontage of seven miles along the sea. During the summer it affords a wonderful spectacle to tourists, for great masses of ice, often larger than an average house, break off and plunge into the water

SOME COAL LANDS SHOULD BE HELD FOR THE NAVY

A fixed minimum annual royalty would conduce to operation and prevent the holding of lands out of use. These are matters, however, of regulation upon which much thought should be expended, and the experience of other lands will be found helpful. If the principle of the homestead law is adopted, and one lease only permitted to any one person or group of persons, and all leases made non-transferable, excepting with the consent of a designated authority, it would seem that monopoly could be prevented. I would, however, add one other precaution—that in each field a large body of the coal land be reserved, so that the public and the navy might be rendered independent of private supplies if that should become necessary.

The attraction of a leasing system is that it enables an operator to put all of his capital into the promotion of his enterprise, no investment being needed for the purchase of the land. This makes it possible for the man of comparatively small means to become a coal mine operator. The lessee is pleased to pay the government a royalty in lieu of tying up a large amount of capital in the land itself.

There is this further consideration, which those interested in Alaska's future might well consider. The royalties arising from these mines (as well as from oil) would for a long time be a source To stimof revenue to the government. ulate the opening of mines, all royalty might well be waived for a brief period; later, however, these royalties would be a not inconsiderable addition to the resources available for Alaskan development, for I would think it the wisest policy to give to this new land the full return from her properties to be used in her improvement, at least for many years.

WESTERN COAL

There are many isolated places in Alaska where small mines may be opened to supply a local and small need. A liceuse to mine a small acreage without any charge whatever on the part of the government would meet this need.

It might be well at this point to consider the coal land situation in the Western States. For the policy I have suggested as advisable to apply in Alaska I think the sensible policy to adopt throughout the rest of the country. We have tried two experiments in the United States as to coal lands. We allowed our coal lands to slip from us under the old land-is-land policy until we came into the presence of a coal monopoly or a series of such monopolies in various parts of the country. If this is questioned we may at least say, with exactness, that we realized that we had been putting priceless assets into the hands of a comparatively few far-sighted men for an inconsiderable consideration.

Then we tried the other plan of appraising such properties on a scientific estimate of contents upon which the land is sold. This is the present plan, and it is really nothing more than a demand for a full but discounted royalty in advance. It has against it, in my opinion, at least two objections. Our coal land is not being used under this plan save under exceptional conditions of local and immediate demand, and the purchaser, when there is one, is speculating on the best guess that an honest geologist can make as to the amount of coal in the ground.*

It is certainly not for the public interest that our coal deposits shall be opened rapidly and ruthlessly. We may reforest lands that have been devastated, or feed again into fruitfulness a soil that is starved, but we cannot replace the car-

*The outstanding withdrawals of public lands valuable for mineral fuels and fertilizers or in connection with the water resources of the public domain now aggregate 66 million acres. The coal-land withdrawals awaiting classification constitute the larger part of this acreage, being 56,316,410 acres on December 4, 1913, not including the blanket withdrawal of coal lands in Alaska. It is noteworthy that a larger area than this has been restored within the past five years, and nearly 20 million acres have been classified as coal lands and are open to entry at appraised prices. The lands classified and restored by executive order to appropriate entry since March 4 last total 10 million acres, every restoration being based upon careful consideration within the Department of the Interior. About 400.000 acres of mineral lands in the same nine months have been withdrawn.



TRAVELING WITH REINDEER IN ALASKA

The cre constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the fixthe Eskimo on the horder of the Arctic Ocean. For the white man we have done nothing; so little, in fact, that to mention what we one is matter for chagrin and humiliation? (see text, page 186).



In 1891 Dr. Sheldon Jackson brought 16 reindeer across the Bering Strait into Alaska; today that herd, with a few importations since, has increased to nearly 40,000, of which some 62 per cent are owned by the natives. From their herds of reindeer the natives enjoyed last year an income of \$44,885.



TOUR ISKING GIRLS NIAR CAPT NOME, MASKA

The dress of the Eskumo convers entirely of skins of seal, reindeer, bear, and fox, the first two being the most common. The dress of the women differs but little from that of the men—a suit with a long jacket and frousers tucked into seal-skin boots. The jacket, which has a hood to cover the head, is often embroidered with strips of dyed leather and is skillfully made. In winter two suits are worn, one with the fur inside,

bon deposits underground, once they are removed. I cannot, however, feel that we should sacrifice any present need for fuel or willingly surrender ourselves to a demand for exorbitant prices because of a fear that some day the coal supply may be exhausted (see page 205).

Irrcady there has been developed a substitute for coal in the flowing stream. The turbine converts melted snow into heat and light, which can be distributed over a constantly widening area. I think we have now arrived at that point in scientific achievement which justifies the belief that the wheels of industry will not cease, nor our houses go unlighted or unheated, so long as dams may be built upon our streams. Water will be—indeed already is—the greatest conservator of coal.

We must seek to make use of our coal, the fullest use that society requires. This principle seems a truism. But here lies the difficulty. We wish cheap coal and at the same time a minimum of waste. We wish society to take the lion's share of the profit and yield no more to the operator than will make his work sufficiently attractive to keep him at it. In short, we desire competition without waste—a frank impossibility.

Other countries have wrestled with this problem. Some have gone into government operation. But those who are nearest to us in institutions and tendencies have found that in a new country, where there must be large development and higher rewards for enterprise, the safest practicable method is to lease the land, the government taking a modest royalty and retaining some measure of control over operation.

OUR OIL, PHOSPHATE, AND POTASH DE-POSITS SHOULD BE DEVELOPED

The United States is beginning to appreciate the extent and value of its oil deposits, and for the disposition of these lands no better plan has been suggested than one analogous to that offered as to coal lands.

I would call your attention to the absardity of applying the placer mining law to the development of petroleum lands. This law, which was based upon

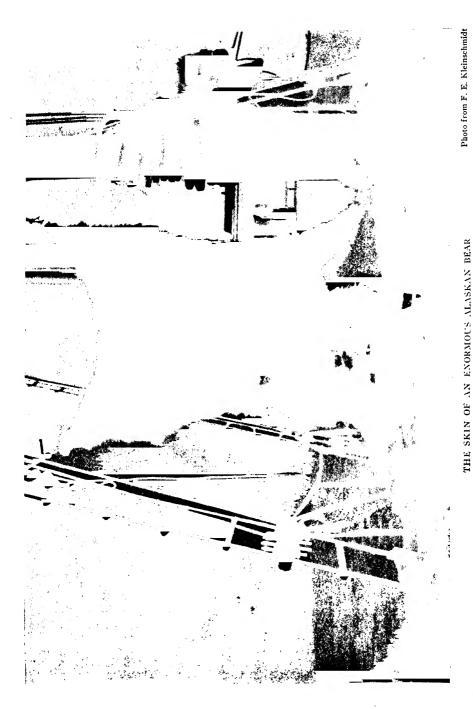
the fundamentals of the miners' codes of early days, was passed without thought of the occurrence of other deposits than placer gold. However, the land department, and later Congress, applied the law to oil lands.

The placer law provides, in the main, that no location shall be made without a discovery of valuable minerals on the claim, that the boundaries of the location shall be plainly marked on the ground, that no claim for an individual shall exceed 20 acres or for an association 160 acres, that \$100 worth of assessmentwork must be done each year, and that upon the expenditure of \$500 in labor or improvements and upon compliance with certain minor requirements the claimant is entitled to a patent to his claim.

The claimant who has gone upon lands for the purpose of making mineral location, and is engaged in work looking to the discovery of minerals, is protected against adverse agricultural claimants on the ground that the land which he occupies is not vacant and open to settlement. The extent of his protection against adverse mineral claimants is, however, a matter of serious doubt. He cannot be ousted by the forcible or fraudulent entry of another mineral claimant, but if such adverse claimant enters peaceably, openly, and in good faith, prospects the claim and first discovers minerals, thus perfecting his location, his title is superior and he dispossesses the original occupant.

On the other hand, in some of the fields large areas are held indefinitely by assessment-work which makes little pretense of exploring the claims or developing them. Useless roads which make the claims no easier of access, drilling rigs incapable of reaching the oil sands, building-stone locations where no building stone is to be found, and locations on worthless deposits of gypsum are among the subterfuges adopted to hold possession of lands prospectively valuable for oil.

Thus, where occupancy without discovery is respected, large areas are withheld from exploration and development, and where such occupancy is not respected the oil prospector must assume undue



This bear, whose skin measured 12 feet 8 inches in length, was killed near Kodiak, in Alaska, for the collection of the Carnegie Museum at Pitts-burgh. The man and the large St. Bernard dog bring out the great size of the skin

The cub hangs on to the mother's tail and is towed along. Sometimes the mother objects to this, and, turning round, severely cuffs the baby or takes it by the neck and puts it under water Photo from F. E. Kleinschmidt POLAR BEAR AND CUB OUT FOR A SWIM

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HAULING A BOILER IN ALASKA

A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a serve inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked" (see text, page 186).

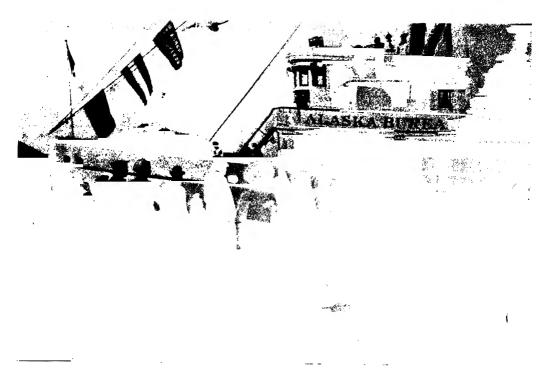


Photo from Leonard Davis

A PAIR OF SALMON, ONE WEIGHING 65 POUNDS AND THE OTHER 82 POUNDS, CAUGHT AT KETCHIKAN: THE PORPOISE SHOWS THE COMPARATIVE SIZE OF THE SALMON

risk of the loss of his investment prior to discovery.

PRESENT MINING LAWS DO NOT SUFFI-CIENTLY REWARD PETROLEUM PIONEERS

An objection of equal force to the placer law as applied to petroleum arises from the fact that the mineral is fluid. It moves underground. A well on one tract is likely to draw from a neighboring tract. Thus it becomes necessary for each operator to drill wells along his boundary lines before his neighbors do so. Otherwise, they will draw off a part of his oil. He is therefore forced to drill whether it is otherwise to his advantage or not, in order to protect his oil deposits from exhaustion through adjacent wells.

We should, I believe, stimulate the search for oil and protect the prospector. The government is withholding from entry certain considerable bodies of land in the belief that they contain oil, when this has not been demonstrated. It is our

practice as soon as there has been a producing well discovered, and sometimes earlier, to withdraw all lands in the neighborhood which, in the opinion of experts, are of similar geological formation. The lands on which the discovery has been made or upon which exploration has been begun may or may not be included in the withdrawal. If they are, the law offers to protect the rights so acquired.

I feel, however, that we are not sufficiently rewarding the pioneer. A plan could readily be evolved by which any one wishing to prospect for oil on the public lands could obtain a license from the government to prospect exclusively a large tract of land for a period of time—perhaps two years—and in the event that oil is found in commercial quantities the government should be paid a royalty fixed in advance.

This method is similar to that by which the Indian lands in Oklahoma have been developed and which has proved of the highest value in bringing capital into this



Photo from Leonard Day

TURNIPS WEIGHING 12 POUNDS GROWN IN A PRIVATE GARDEN AT RAMPART, ALASKA

"And in agriculture the government itself has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally" (see text, page 185).

work and insuring large returns to the Indians. In the Oklahoma case one great corporation, however, was given so large a body of land that after the original discovery it found it profitable to farm out its rights to subsidiary companies. This might easily be prevented by regula-

tions under which the government would reserve to itself the adjoining lands.

Indeed, I would not be adverse to granting such a license in unexplored country for, say, four sections of land, and in the event of discovery permitting patent to issue to the discoverer for a full



DIAGRAM ILLUSTRATING OUR COAL RESOURCES, THE AMOUNT THAT HAS BEEN USED AND THE AMOUNT STILL REMAINING UNUSED IN THE UNITED STATES

A represents the total coal supply of the United States. B represents the amount used to the end of 1912. C represents the amount consumed in a single year. This diagram was prepared by Edward W. Parker, Chief of the Division of Mineral Resources of the U. S. Geological Survey.

section, the balance of the licensed land to remain in the government to be leased in small parcels to other parties on a royalty basis under the more advantageous terms that could then be secured.

THE NEED OF OIL FOR THE NAVY

The United States will need oil for its navy as well as coal, and probably in increasing quantities as the modern oil-burning or gas-burning engines are recognized. It would be economical to substitute oil for coal for many reasons; the reduce labor cost, to avoid the building

and maintenance of colliers, and the purchase and support of coaling stations.

The Diesel engine can, with the fuel carried from the home port, take one of our greatest ships around the world without dependence upon a renewed supply of fuel. England's adventure in this direction will presumably force other nations into like enterprise, and yet England has no oil fields on which to draw, while we have already the largest producing fuel-oil fields in the world, and others are appearing.

Already we know of oil in Alaska, and

Photo from Bureau of Mines of the Department of the Interior

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A CANARY USED AS A PROTECTION IN MINE RESCUE WORL

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It has been found that canaries will show signs of distress at the presence of harmful gases in mines long before human beings are aware of any danger. It is now the practice to carry one of these birds with all rescue parties, as it will indicate the point beyond which it is not safe to proceed without wearing protective helmets.

within a few weeks a fine grade of oil has been found on the Quinaielt Indian Reservation in Washington. The Indian oil lands we do not own. They belong to the Indians, and their product must be sold for the Indians' profit.

The one sole reservation of oil lands for governmental use is that in California, over the withdrawal of which litigation is now pending. Under these conditions it would seem of the highest expediency that the government make such offers as will induce the proving of our lands, and of these proved lands retain sufficient to make our ships independent of the world and as fully competent as their rivals.

Some years since the Department of the Interior announced the discovery within the United States of a deposit of potash which it was hoped would render our farmers independent, for a time at least, of all other sources. This deposit still lies unused. No proper laws have been passed by which it can be put into use. A common-sense view of the matter would be to treat these lands as it has been suggested we should treat coal lands.

So, too, should our vast deposits of phosphate rock, undoubtedly the world's world's supply. We are giving a constantly increasing volume of thought to the scientific methods by which the fertility of our soils may be increased. And the time is likely to come when the deposited phosphorus in our western lands will be regarded as of almost priceless worth.

Few appreciate how very extensive these deposits are. They run for hundreds of miles through Wyoming, Utah, Montana, and Idaho, and in other States similar deposits of lesser extent are known to exist. We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock; undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported. It would certainly be well if we could insure the preferential use of this fertilizer on American farms and export it in the form of farm products rather than as raw material.

TIMBER LANDS

I am not satisfied with the operation of the homestead law as to the timber lands of the far western lands. As the law now is, a man may enter upon 160 acres of these lands, and by living a total of 21 months on the land during three years and cultivating at a maximum 20 acres of the land it becomes his. He promptly proceeds, if he is wise, to sell it to some lumber company for from \$10,000 to \$20,000. The land is allowed to lie for an indefinite period as a part of the company's forest reserve or is logged off, leaving the stumps in the land, and eventually sold for agricultural pur-

poses, if so adapted.

Experience justifies the statement that few men take up these heavily timbered lands under a bona fide attempt to meet the purpose of the law, which, as its name implies, is to convert the public land into homes. By the investment of a few months' time and a few hundred dollars the homesteader gains a property worth many thousands of dollars. Yet all the conditions of the law are complied with and patent must issue. The government loses the timber and the land and does not gain a real home-maker. Such homesteaders add nothing to the wealth of the nation. The law should punish them, in fact, as frauds. Whether with the connivance of the lumber companies or not, they are the agencies by which the law is defeated and the lands conveyed where it is not intended that they should

There is a remedy for this condition of things, and it lies in the selling of the land and the timber separately. I am beginning to doubt the wisdom of applying the homestead law to any land which has not first been declared fitted for agriculture. It is now a blanket law which is used to cover a multitude of frauds. Such legislation would also cure the abuses resulting from the use of certain classes of scrip.

THE ARID LANDS OF THE GREAT AMERICAN DESERT

"The Great American Desert," as it was designated upon the map some 40



"We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock, undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported" (see page 204).

years ago, has become one of the richest portions of our country. This desert included a variable area, generally all west of the Missouri River to the Sierra Nevada. Today it is harvest field, cattle range, mining camp, and orchard—where there is water. And where there is no water it remains desert.

There are at least four States which can never increase greatly in stable population unless their lands are brought under irrigation. And in all of the Western States there are tens of thousands and in some millions of acres that will remain waste land, fit only for the poorest cattle range, and much not even for that use, without the expenditure of large sums for reservoirs, dams, canals, and ditches.

That there is not water enough even with the fullest storage to supply the demands of all the arable land can safely be said. That, however, there is sufficient to care for a large part of this territory and bring it into fruitfulness there is no doubt.

The government, seeing this condition, undertook to lend itself to the development of these lands by what is known as the Carey act. This was a form of cooperative effort in which the Federal government turned over any required body of lands to a State, which the latter undertook through private enterprise to When to irrigate meant nothing irrigate. more than to divert a portion of a stream from its bed and convey it by gravity to the desert, this plan was attractive. since these simpler methods had to be abandoned as no longer adequate, this act has done little in the promotion of such enterprise.

The successful Carey act projects are a distinguished few. Great wrongs to trustful or none-too-wise farmers were done in its name, and the suffering which it caused has made it difficult to make it serviceable, even under the more careful scrutiny of later and more cautious officials.

THE GOVERNMENT'S RECLAMATION WORK IS A SUCCESS

Because of the magnitude of the money investment required, and apprecia-

tive of the need, Congress in 1902 adopted the policy of undertaking irrigation projects of its own. The moneys received from the sale of public lands—less 5 per cent-went into a reclamation fund, administered by the Department of the Interior. The result has been the construction of some 25 projects, scattered through all of the arid-land States. these the government has invested approximately \$76,000,000. One of these, a pumping plant in Kansas, is now unused; another, a flood-storage system in New Mexico, is only in partial use; both of these, however, represent less than I per cent of the total investment. others are in operation, and less than 3 per cent of all the land which is served or which we are ready to serve is unoccupied. This work has been a success.

Soon after taking office I received a number of letters complaining of the reclamation service. To inquire into these complaints I first called a conference in Washington of representatives from all the projects and later visited most of those from which most serious complaint had been received. I cannot here review the matters considered or the information gained. My conclusion was that mistakes had been made by the service, some of which grew out of ambiguities or defects in the law, some out of inexperience, and others out of a misconception of the relationship that should exist between such a governmental service and those with whom it was dealing. larger degree of frankness with the farmer on our part and a fuller appreciation of the responsibilities assumed on the part of the farmer will mend much of the feeling that I found.

RELIEF FOR THE USERS OF WATER RIGHTS

But there is one matter of great moment to these people which should be corrected by law as soon as possible. We mistook the ability of the farmer to pay for his water rights. Ten years was the time given. His optimism and our own was too great. That time should be doubled. This should be done not alone because of the inability of many to meet their obligations to the government, but because it will prove wise policy to give



THE GAPAT MISSISSIFI FOWER DAY AT ALONCA

Photo by Anschutz

This great dam across the Mississippi forms the largest water power plant in the world. It is nine tenths of a mile in length, while the power house is a third of a mile long half a city block, wide and as high as a 15 story sky scraper. Over \$27,000,000 have been spent in the construction of this plant, which will produce 310.4.8 mechanical horsepower at least two-thirds of which will be available for manufacturing purposes. Each horsepower developed in a manufacturing community eventually supports have persons, so that it is estimated this new dam will support one million new inhabitants within a radius of 150 miles of Keokuk,



THE GENERATORS OF THE LARGEST WATER-POWER PLANT IN THE WORLD

The picture shows part of the row of 30 electric generators in the power-house at Keokuk. Through these generators the flowing stream of the Mississippi is converted into heat and light. From them electric power will be sent to St. Louis, 137 miles distant, where it can enter into successful competition with the cheapest coal and the cheapest steam power in the United States. Photo from Anschutz

a free period within which the farmers may more fully use their farms. They can put their lands to a more profitable use, both to themselves and to the country, by being allowed to cumulate their earnings in the early years and be thus enabled to make investments in stock and machinery which will make for larger profits later.

I feel the keenest sympathy with those upon these projects who are entering into this work of putting the desert into public service. They are genuine pioneers in a new field of work, on the success of which depends greatly the rescuing of a The enemy of the govvast territory. ernment and of the farmer is the land speculator. He is of two kinds. times he is a farmer who does not expect to farm but to sell out at a higher price and go elsewhere. Generally, however, he is the holder of a large tract of private land within the project, who creates false values and burdens those who buy and attempt to farm with a load of debt which handicaps them in their efforts. Both of these are hostile to the welfare of the enterprise and tend to destroy the value of the service which the government is attempting. But such matters may, I trust, be overcome by new methods of administration.

It is my hope that the government will find its way to enter with zest upon more works of a similar character. Not to do this will leave undeveloped much of the most fertile land of the West. What is to be the future of Arizona and of New Mexico, of Nevada and Utah, of southern Idaho, central Oregon, eastern Washington, much of Montana and Colorado, and more of Wyoming and Nebraska, if the government does not aid in their development?

Private capital will not, for many years at least, risk undertakings of such magnitude as these States require. Experience has made the irrigation-bond buyer extremely wary. Within a few weeks the most promising of the great private enterprises in Idaho has met with the misfortune which had befallen so many others in neighboring States. The most successful irrigation plants are founded on the wrecks of their pioneer exploiters. The government has rescued others.

It has been with these projects much as it has been with our western railroads. They had to descend into the hands of the receiver before they could be resurrected into a new and glorified life.

THERE IS MUCH MORE IRRIGATION WORK
FOR THE GOVERNMENT TO DO

But where are the funds to come from to carry on such work? My answer is, From the public lands in these States. We sell these lands now and the proceeds go This is the into the reclamation fund. policy of Congress—that we shall for a time use the moneys which the government derives from the sale of its lands to create new values within the States. Two years ago the government went further and set aside \$20,000,000, to be used in the completion of the irrigation schemes now under way. This is an advance by the government for which it takes what might be termed a mortgage on the moneys which the projects will yield from the sale of water rights. not extend this policy?

The West can use profitably and wisely \$100,000,000 in the next 10 years to the advantage of the whole country. Indeed, without this expenditure the asset which the government has in its desert lands will lie unused and be of no national value. The government will recover all of the money it advances, not to speak of the homes and the values created by its enterprise.

If the government will place upon a leasing basis these western resources with which we have been dealing, it can have an increased fund for the continuance of this work and an increased assurance of the return of its advances. Just as I would aim to make Alaska pay in the end out of her own resources for a liberal advance made to her for the opening and improvement of her territory, so should we aim to make these lands of the West bring into being the latent values of the West. With a little foresight we can transform coal and oil, phosphate and timber, into green fields and electric power.

Railroads and power plants, street railways and waterworks, are built with 50-year bonds, which rest upon the foundation of their probable earnings.



A LOCOMOTIVE IN MID-AIR Photo from U. S. Reclamation Service

Moving an engine from the bottom of the site of the Arrowrock Dam in Idaho to the top of the future spillway, 350 feet above. The Arrowrock Dam, which is part of the Boise Reclamation Project, will be the highest dam in the world.



GROWING APPLES IN FIII, DESERT

Photo from U. S. Reclamation Service

This thriving voung apple orchard is growing on what a few vears ago was part of the desert plain of Idaho. This transformation is due to the water furnished by the Boise Project of the U.S. Reclamation Service upon which the government has spent more than eight million dollars. Ninety-seven per cent of all the land which is served by the government reclamation projects, or which is ready to be thus served, is occupied (see page 209).

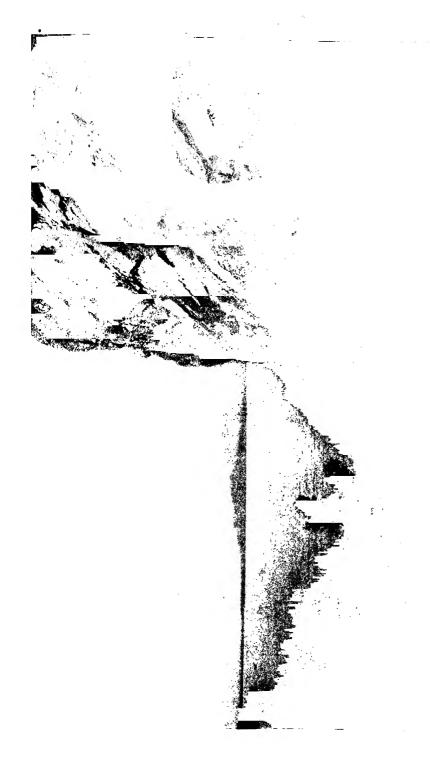


Photo from U. S. Reclamation Service

"Stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town and farm. These two—irrigation and hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate" (see text, page 219). THE GREAT GOVERNMENT RESERVOIR AND TWIN TUNNELS, THREE-QUARTERS OF A MILE FROM THE SHOSHONE DAM, WYOMING



Photo from U. S. Reclamation Service

THE MCDERMOTT LAKE AND FALLS, MONTANA

The dam of the St. Mary Project of the Reclamation Service will be built across the canyon at the foot of the falls shown in the picture. While it will destroy the beauty of these picturesque falls, it will be the means of bringing under cultivation great tracts of land which are now arid.



AN ICE WALL ON MOUNT RAINIER

Photo by A. H. Barnes

This great ice wall, with its face of 400 feet, stands on the upper part of the mountain. Mount Rainier, the Great White Monarch of the Pacific Northwest, is included in the Mount Rainier National Park and is one of the wards of the Secretary of the Interior.



CALIFORNIA INDIAN MOTHER AND HER BABIES

California has an Indian population of over 16,000, who are looked after by the office of Indian Affairs of the Department of the Interior. The Indian Service has some 6,000 employees distributed over twenty-six States, and it administers one billion dollars' worth of property which belongs to the various Indian tribes.

It is not without precedent in principle or in fact for the United States to improve its own property and for its advances take a mortgage upon the wealth it creates, and in one-half of 50 years we would regain our capital.

Inasmuch as the title to these oil and other lands would remain in the government and be excluded from State taxation, it would seem to be fair that a certain percentage of the royalties received should go to the States within which the revenues are raised. Twentyfive per cent might be a minimum, but a higher percentage would seem advisable if the whole might remain for a time in the government's hands to be used in such cooperative irrigation enterprises as the State might desire, and after such use has been made and the fund replenished, be fully released to the State.

COÖPERATION OF THE FEDERAL GOVERN-MENT WITH THE STATES

This suggestion of coöperation with the State is not made idly. I look forward with confidence to a more intimate relationship between the States and the Federal government in undertaking this work of developing the West. The mass of the people are sympathetic with the purposes of the government. They regard with pride the great engineering works of this service, which stand as monuments to the interest of the nation in their welfare.

So cordial, indeed, is the spirit of the West toward this work that within a few months the State government of Oregon and the Federal government, through the Reclamation Service, have become partners in several projected irrigation plans, one involving no less than the pumping of water from the Columbia River by electric power generated by the river itself. A similar coöperative enterprise has been entered upon with the State of Washington.

The plan is that we shall do the work, supplying one-half the funds and the State one-half. This is a tendency which it is well to foster; for the State will well appreciate the effort of the nation when it makes like sacrifice itself. And nothing could more induce to the success

of the nation's effort than to have some local check and interest. To place at a State's service a large sum gathered from the resources of the public lands within her borders would enable this character of mutual effort to expand.

This can be done if we will retain for national improvement a portion of the national resources. And this may be done, I believe, with the hearty good will of the people who are chiefly concerned—

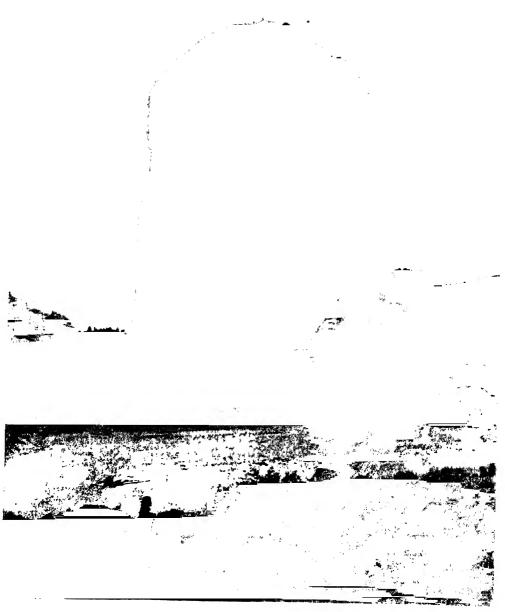
the people of the West.

One reason stands out demanding the promptest possible action in this matter. Reservoir sites are few and becoming fewer each succeeding year. Those that may be had are rising steadily in value. So valuable, indeed, have some sites become since the institution of the Reclamation Service that projecte i enterprises are not now regarded as feasible, for the dependent lands which it was intended to irrigate can not make a return sufficient to pay the increased cost.

And let this not be forgotten, that stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town These two-irrigation and and farm. hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate. Electricity is coal and kerosene which need no railroad to transport them. The significance of these irrigation reservoirs from this point of view is but beginning to be appreciated and will grow greater as the country becomes more thickly populated and factories come to supplement the farms.

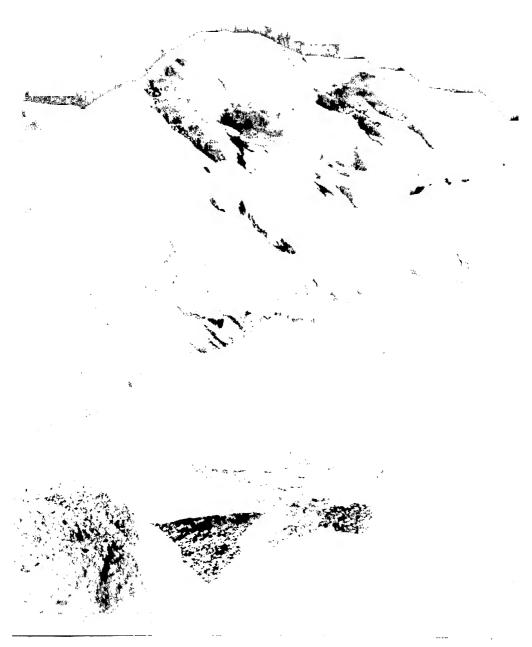
THE ENORMOUS VALUE OF POWER SITES

And this brings me to the consideration of the government's policy toward the use of the public lands for reservoir and dam sites. It is one of the most perplexing problems that engages the mind of the man who wishes to see the West thrive more abundantly. What is such land worth? Are we justified in measuring its value by the use to which it is put, or should we yield this strategic resource without compensation?



ONE OF OUR NATIONAL MONUMENTS

This towering mass, known as Monument Rock stands in the Canyon de Chellev in Navajo County Arizona within an Indian reservation. It forms part of a collection of natural wonders situated in an area of 360 acres which were declared National Monuments in 1912, and as such are preserved by the Department of the Interior



(,UNSIGHT LAKT TROM MOUNT JACKSON Copyright, Kiser Photo Co.

One of the beauty spots in Glacier National Park, Montana The national parks are under the jurisdiction of the Secretary of the Interior, who is charged with the duty of preserving the wonders of Nature contained in them from desecration. Glacier National Park contains over 900 000 acres and is the voungest of our twelve parks



The ridges are of white sandstone, containing the carnotite ores from which radium is extracted. The Secretary of the Interior, Mr. Lane, has recommended that the President be empowered by Congress to withdraw from the public domain lands containing carnotite, pitchblende, or other minerals or ores from which radium may be derived. The law at present does not permit the withdrawal of mineral lands except coal, oil,

The country has been aroused too late to save the very richest of these points of vantage. Private power companies hold the most accessible of these sites under rights of which they can never be deprived.

So much more compelling the reason why we should not yield what remain unwisely. The temptation to grant generously without condition that which may be put to so beneficent a use must be resisted if we are not to meet a spendthrift's fate. At the same time there must surely be a rational way by which capital may be brought into this public The present condiservice. tion of stagnation does no one good. Within a generation I believe the people will be as alive to the value of public ownership of hydroelectric power plants as they are today to municipallyowned waterworks.

The people not being prepared, however, to proceed to put these lands to their highest use, I am not in favor of keeping them from being utilized by private capital in the public interest. Because we do not know what is best to be done is not a reason either for doing nothing or for getting rid of the trouble as soon as possible, on the old "land-island" policy.

How may the needed advantage be gained for the present and the needs of the future be cared for? This is the immediate problem. What may capital reasonably demand? A fair and attractive return upon its investment yearly and the full return of its capital. And what may the public served reasonably require? Good service and fair rates. Who

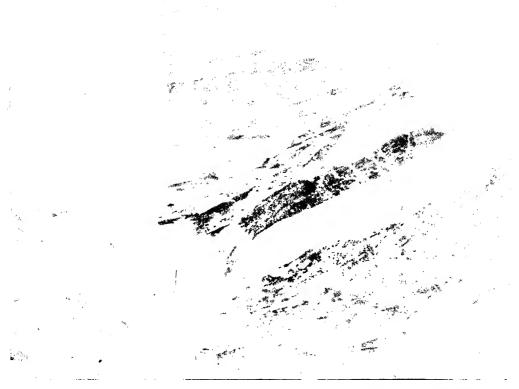


Photo from U. S. Geological Survey

IN THE RADIUM COUNTRY: COLORADO

The greater part of the world's supply of radium is obtained from radium-bearing ore mined in the United States. At present the ore is exported to Europe, where, in the laboratories of France, Austria, Germany, and England, the radium is extracted from it. There appears to be in the United States today less than two grams of radium—that is, less than one-fourteenth of an ounce. This is valued at \$120,000 a gram. Thus while we are supplying the world with radium, we have practically none at home, as heretofore no steps have been taken to preserve for our own people this invaluable metal.

shall make these rates? Within the State they must be subject to State regulation; between the States, Federal authority must control.

WHAT WILL THE GOVERNMENT RECEIVE FOR ITS LANDS?

What return shall the Federal government have for its lands? My answer would be, no return whatsoever, provided the plant reverted to the government without cost at the end of 50 or 60 years, or so much of the plant as was based on the land itself and the improvements directly attached thereto, such as reservoirs, dams, water rights, and rights of

way. For the tangible property of the plant, such as the distributing system and machinery, the government might well agree to pay an appraised price, so as to insure its being maintained and extended during the later years of the life of the franchise.

The right to buy the complete plant at an appraised figure at any time after 20 years would be a further protection and one not burdensome, while for better service it would seem advisable that all plants be permitted, in fact encouraged, to combine physically, just as our railroads are required to couple themselves into through routes and thus make their



Photo from U. S. Bureau of Mines

IN A COLORADO RADIUM MINE

This picture shows the 4-foot stratum of radium-bearing ore, carnotite and vanadium in the Cliff Mine, Paradox Valley, Colorado. Radium is found in ores carrying uranium and vanadium, which are used extensively in the arts, and the processes by which it is extracted are secret. A process has been invented by the chemists in our Bureau of Mines which promises, from the laboratory experiments thus far made, to be successful. Under the endowment of two Americans, a building is now being erected in Denver (which, with its equipment, will be opened for work in the coming month) in which an effort will be made to prove the commercial possibility of this American process. If successful, this process will be given to the world, and all of the radium secured over and above a small minimum will be the property of the United States, and will be put into the hands of the United States Hospital Service for public use.

service continuous and interdependent; but they should not be allowed either to agree as to rates or to merge their capitalization or their identity.

Such plan as is here suggested should be attractive to capital wherever there is bona fide need for such water-power development, for it is definite in its terms and can be made a precise basis for capi-The term of the franchise talization. would be long enough to permit of the amortization of the plant upon such a percentage as would lay no heavy burden upon each year's earnings.

Where a reservoir site is also used for the storage of irrigation waters, the right to which attaches to certain lands which

should enjoy that use forever, it could be provided that at the end of the franchise period the government would either turn over the plant to the water users or the State or otherwise provide for its operation.

I have endeavored herein barely to outline such a constructive program as would meet any reasonable demand and with the least burden place our resources at the service of the people. It should not be impossible to hearten the hopes of those who live in Alaska or the many who would engage in her development were the doors of opportunity open to them. And if we can follow some such plan as has been suggested, by which, sensibly

and conservatively, the resources of the West may be utilized for her upbuilding and improvement by the fullest recognition of their interdependence, I believe that we would meet the demands of all whose ambition to gain fortune has not closed their eyes to the general good.

WHAT THE DEPARTMENT OF THE INTERIOR DOES EACH YEAR

The Department of the Interior has to do not alone with general policies, but with an infinitude of administrative detail. Its embarrasments arise out of the large number of matters as to which administrative discretion may be exercised. That you may, however, appreciate the scope of the department's activities, permit me to note here that we care for the Eskimo in Alaska and for the insane in the District of Columbia; for 324,000 Indians scattered throughout the continent, for whom we hold property in trust approximating in value \$1,000,-000,000; that the choice beauty spots of our country have been set aside as national parks, which are in our care; that we distribute to over 800,000 pensioners, their widows and dependents, a round

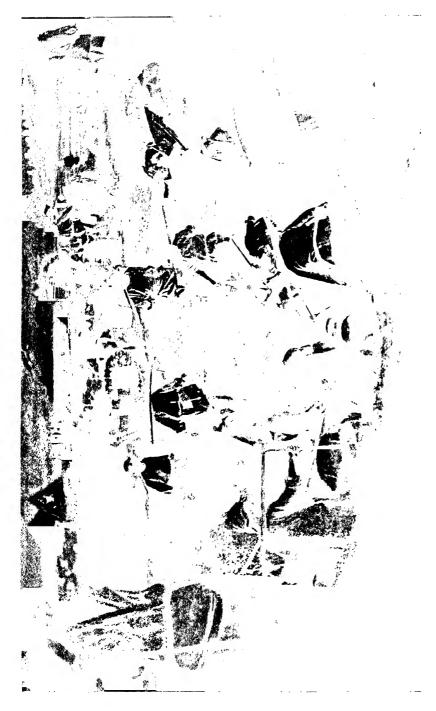
sum of over \$165,000,000 a year; that we issue to inventors of the United States and foreign countries an average of more than 3,000 patents each month; that every miner in the land is interested in those means which we are taking to prevent mine accidents and more fully to realize the mineral wealth of the land; that the schools of the Indians and the national university of the colored people are under our jurisdiction, together with the Hot Springs of Arkansas and the cliff dwellings of Colorado; that the internal economy of the Territory of Hawaii, as well as that of Alaska, fall

A RADIOGRAPH OF A KEY

This picture was made by placing a key on the outside of a light-proof plate-holder containing a photographic plate. A block of radium-bearing ore three-quarters of an inch thick was then placed on the key and the photograph resulted.

within the purview of this department; that it is our part to measure the waters of a thousand streams, survey the lands of all the States, and look beneath the surface to see what they contain; that we have still in our care a great body of public land (some 300 million acres outside of Alaska), out of which each year approximately 60,000 farms are carved; that we have a bureau of education, which should be provided with the equipment by which it may adequately do a great work for the schools, the teachers, and the children of this country, or be abolished.





CHINESE SALT WORKS

Deposits of salt are very numerous in China and the production of commercial salt is a government monopoly. At the producing center the salt costs about three-eighths of a cent per pound, but when shipped by the government to the distributing centers it sells for eight and often ten times that amount. Hence the importance to China of the salt gabelle, as it is called, of which the foreign powers are now trying to get control.



AT THE COLLEGE OF INTERPRETERS, HA-NOI

The French, since their arrival in Tonkin in 1884, have pursued a very liberal educational policy. Primary schools have been established at convenient points, and a college of medicine for natives exists at Ha-noi, as well as the College of Interpreters, which is designed to give natives a thorough training in the French languages. The students are mainly Annamese, but there are also a few Chinese. The collegians live together during their course and it will be observed that at table they follow European customs.



AT STUDY IN A BUDDITIST MONASTERY Photo by Dr. W. F. Grubl

The children are studying the Buddhist Scriptures, which are written in a language called Pali on curious oblong tablets made of palm leaves. The monks are distinguished by their shaven heads and by their single garment, the famous yellow robe. In Burma all boys become monks for a year or two and in this way a part of their education is acquired.



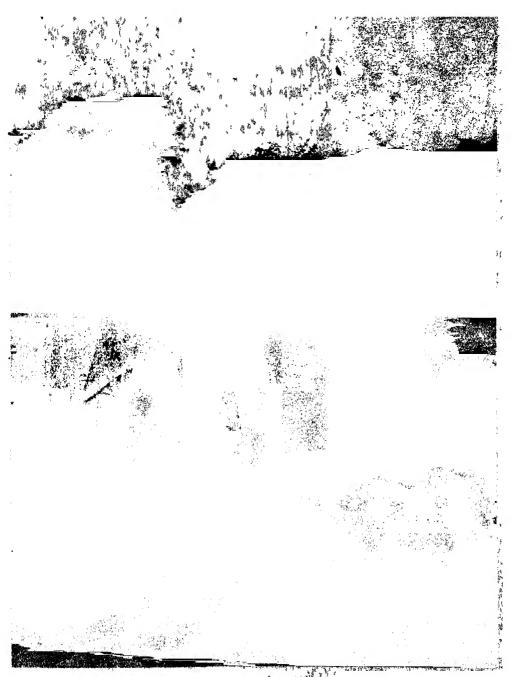
A WAYSIDE SCENE IN RURAL ENGLAND

The entrance to one of the quaint old cottages in the village of Cockington in the south of Devonshire. All the houses in this village have thatched roofs and are very old; many of them have been standing for over three hundred years. Photo by A. W. Cutler.



SOME ENGLISH CAVE DWELLERS

rears. Before the Reformation, the rock was be grandson now live in the Rockery which This is one of a group of rock dwellings known as Holy Austin Rockery in Worcestershire, England. Recent investigations have proved this to be the oldest inhabited rock dwelling in England, its earliest occupation dating back 900 years. Before the Reformation, the rock was occupied by Augustinian friars whence it derives its present namer. This old lady and her little grandson now live in the Rockery which ms with rough untrimmed walls and crilings. several r



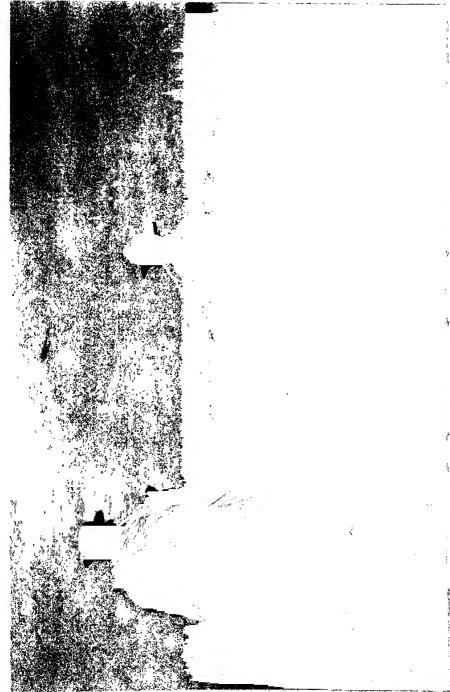
A BIT OF OLD WALES

This old fish-wife is wearing the last disappearing Welsh costume, the most curious feature of which is the high beaver hat worn over a frilled muslin cap. The top basket is used for cockles and mussels, the lower one for fish. The picture was taken at Llangura in South Wales. Photo by A. W. Cutier.



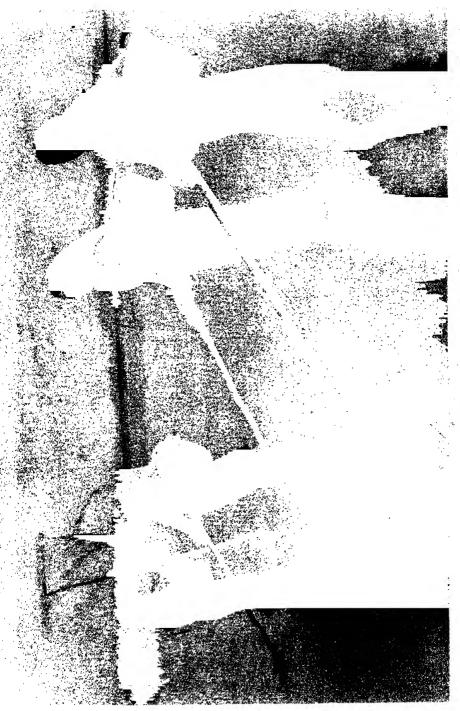
A REST BY THE WAY

A quiet scene in the countryside of Belgium near the French border. The old man is on his way home with his little granddaughter, seated in the cart drawn by dogs. These dog carts are often seen in Belgium and Holland, bakers, milk dealers, and peddlers using dogs to assist in the distribution of their wares.



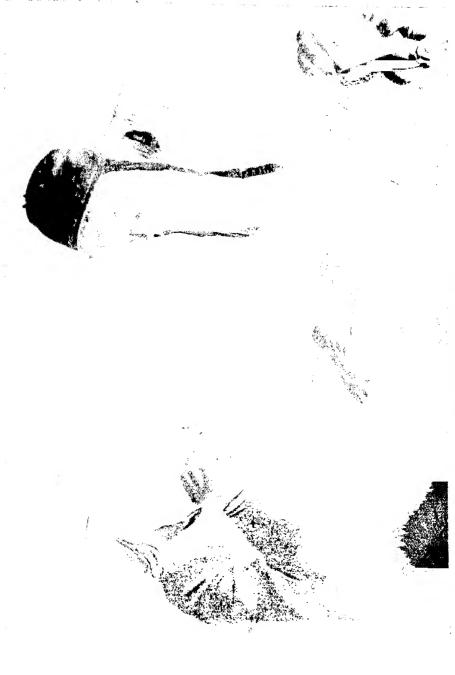
SHEPHERD BOYS OF THE CREAT HUNGARIAN PLAINS

so are the long pipes. The younger boy is not wearing akirts but trousers so full and haggy that simple attire. Photo by A. W. Cutler.



SHRIMPING IN NORMANDY

Along the Norman coast, where shrimps are abundant on the sandy shores, this is a common sight at low tide. The girls wade through the shallow water pushing their nets before them and transferring the shrimps, as the nets fill, to the baskets on their backs.



AT THE SPINNING-WHEEL

Brittany today remains the most primitive part of France. The peasants cling tenaciously to their ancient costume, the men to their short, velvet-trimmed jacket and the huge broad-brimmed hat with great streamers of ribbon hanging down behind. The women wear white tage, the their which is different in each locality.

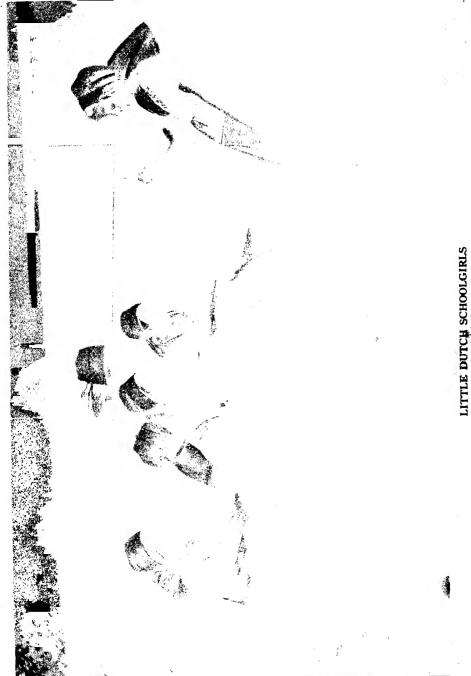


Along the coast of Brittany are found perhaps the most intrepid fishermen in all France, and strangely enough hardly one of them can speak a word of French. They have a Celtic language of their own, not unlike the tongues of their cousins, the Welsh and Irish, on the other side of the English Channel.



HUNGARIAN MOTHERS AND THEIR BABIES

Hungarian peasant women have a curious custom of swaddling their infants on immense pillows. The k tume, the skirt of which is embellished with a number of vari-colored ribbons hanging straight down from the have their hair consequent cone-shaped baskets, a universal custom in this section. Note the kitten.



In the outlying districts of Holland, especially on the islands of the Zuider Zee, many quaint costumes are found. The caps the girls are wearing are held in place by coiled springs of gold set over each temple. These springs are often of ancient workmanship and great artistic merit.



SLOVAK GIRLS IN THEIR BEST, HUNGARY

To see these girls, coming from church on Sunday, in all the glory of their best, it is difficult to realize that throughout the week they work in the fields from early morn to sundown. A curious feature of this much be-ribboned costume is the lack of head-dress. The girls week in schelings—just a cloth bound round the foot to make the high boot fit snugly. Photo by A. W. Cutler.



A FAMILY GROUP IN HUNGARY

These peasants have a passion for embroidery. Note the long black apron worn by both sexes, with its richly ornamented designs in colored wools—sometimes in silks. The puffed sleeves of the women are very stiff and uncomfortable, in striking contrast to those of the men, which are flowing and beautifully worked. Photo by A. W. Cutler.



THE BRIDE AND BRIDEGROOM, HUNGARY

The enormous ornament on the bride's head is not so heavy as it looks, being composed largely of tinsel. It will be noted that the bridegroom's hat is also gay with flowers and tinsel. Note the ribbons hanging from the bride's belt, as also on page 237. Photo by A. W. Cutler.



PEASANT LIFE IN SICILY

A typical scene among the peasants of the mountains of Sicily, where this picture was taken in the streets of the little village of Mola. The old man has come in to market on the family donkey and is offering an orange to the grandchild of one of his cronies. Photo by A. W. Cutler.



The old lady on the left has dropped off into a doze while watching her turkey and chicks. Note the woman looking through the hole had a corner of the room on the stone-flagged floor.

SOME JOLLY SICILIAN BOYS

These youngeters come from a little mountain village just above Tagamina in Sicily. Thous are as happy as the birds in May, and if a few pennies are forthcoulding there is no repressing

THE PROBABLE EFFECT OF THE PANAMA CANAL ON THE COMMERCIAL GEOG-RAPHY OF THE WORLD

By O. P. Austin

HAT will be the effect of the Panama Canal upon the commercial and travel geography of the world? Will it change travel routes, stimulate commerce, and bring the people of great land-masses into

closer relationship?

The Suez Canal, opened in 1869, shortened the travel distance between western Europe and eastern Asia by 3,400 miles, and in doing so opened new highways of travel and traffic, multiplied interchanges of merchandise, and developed closer relations between the Occident and the Orient. The Panama Canal will shorten travel routes between New York and Yokohama by 3,750 miles; between New York and Shanghai, about 2,000 miles; between New York and Australia, about 3,000 miles, and between New York and western South America by from 3,500 to 7,000 miles. It will also reduce the distance from Europe to western South America by 3,000 miles and to western North America by more than 5,000 miles.

Will it also divert travel and traffic from the present established routes, stimulate commerce, and develop closer relations between the people of the countries

thus brought closer together?

International commerce doubled in the 30 years following the opening of the Suez Canal, and business and personal inter-relationship between the Occident and the Orient was increased in like proportion. Will similar results follow the like shortening of trade and travel routes by the Panama Canal?

WHAT DETERMINES STEAMSHIP ROUTES

Highways of travel on the ocean are influenced by surrounding conditions just as are those on land. The shortest distance between two given points is not always the best on the ocean any more than is the case on a continent or island. True, the ocean surface gives a level

"road-bed" for a direct line of travel, while a route over a land surface must make frequent detours to obtain even approximate levels for moving great quantities of merchandise.

But there are other important conditions which affect the ocean route. Plentiful freight supplies, present and prospective, interchangeability of the products of the countries forming the termini of the routes, "way stations" on such routes, plentiful coaling stations, and cheap coal of a quality suitable for steamship engines, and even favorable winds and ocean currents are among the factors contributing to the success of routes of travel upon the ocean.

Argentina, for example, has ample supplies of freight, but steamship lines do not develop rapidly between that country and the United States because most of the Argentine products are similar to our own, and there is no reason why she should send her wheat and corn and pork to this country, which has a surplus of those articles. Cuba, the world's greatest producer of cane sugar, sends little if any of it to Europe, because that part of the world produces from beets all the sugar it requires. England, the world's greatest coal exporter, sends no coal to the United States, which has unlimited supplies of her own. So, shortening of distances between great sections will not develop steamship business unless the products of the two sections are of such character as to justify exchanges.

In some instances, however, steamship routes adjust themselves to locally adverse conditions. The steamer which carries wheat and corn and meat from Argentina to Europe may bring the silks and woolens and laces of Europe to the United States and then return to Argentina loaded with agricultural implements. iron and steel manufactures, and mineral

oil from the factories and refineries of this country.

THE IMPORTANCE OF COALING STATIONS

Coaling stations and coal supplies are an important factor in determining routes of travel for steamers. The stations are numbered by hundreds and scattered over the entire travel world, yet the quality and prices of the material which they offer and the distances between ample and cheap supplies have much to do in determining steamship routes.

British coal is the standard for steamships in Europe, the Mediterranean, and western Asia: India, Australia, and Japan are the chief sources of supply for eastern Asia and the western Pacific, and the United States chief purveyor to all of America and adjacent waters. Australian, Japanese, and American coals are somewhat cheaper than the English, and if the stations tributary to the Panama routes were so near to each other that the steamship could get supplies at frequent intervals, and thus devote most of its carrying space to merchandise rather than to large coal supplies, the routes via the Panama Canal would offer special attractions.

Coal is nearly one-half the cost of running a freight vessel. A large share of the freight now moved on the ocean is carried in "tramp" steamers of from 3,000 to 5,000 "net register" tons capacity, but an actual carrying power of about twice as many tons of dead weight.

To charter a vessel of, say, 3,000 register tons, including the officers and crew, costs about \$200 a day, while the coal required to run such a vessel at the very moderate speed of 10 miles an hour would cost about \$150 per day. For passenger steamers, making higher speed, the cost of coal is much greater, and would probably be quite as much as the hire of the vessel and all of her officers, crew, subsistence, and incidental expenses.

A freight vessel of the type above described, carrying about 5,000 tons dead weight and making about 10 miles per hour, would probably burn about 3,000 to 4,000 tons of coal on a trip from New

York to Yokohama or Shanghai and return, and if a saving of \$1.50 per ton could be made by going via Panama and using the cheaper coal offered by that route, the economy in coal alone might turn the scale in favor of that route.

So it is apparent that coaling stations, coal supplies, and coal prices are factors of considerable importance in determining the choice of routes where distances are nearly equal.

THE SPHERE OF INFLUENCE OF THE PANAMA CANAL

The sections of the world which may be considered as probably within the "sphere of influence" of the Panama Canal are the eastern and western coasts of America, the eastern coast of Asia, and the "islands of the Pacific. All of western America will be nearer to Europe than at present, and all of western America and most of eastern Asia and Oceania will be nearer to the eastern coast of America than at present.

A study of the production and consumption of the various countries lying within the canal's sphere of influence shows that their various products are thoroughly interchangeable. The western coast of South America offers chiefly Chile has nitrates, natural products. copper, and comparatively small quantities of wheat and other grains. The nitrates are needed by both the United States and Europe; the copper comes to the United States to be smelted and refined and the grains are wanted by Europe. In exchange for these Chile takes manufactures, and both the United States and Europe have manufactures for sale in ever-increasing quantities.

The Philippines and the Dutch East Indies offer sugar, tobacco, hemp, and other tropical products, and both Europe and the United States want these and pay for them chiefly in manufactures, which form the bulk of the imports of these countries. Australia and New Zealand offer meats, wool, and hides and take manufactures in exchange; and both the United States and Europe want the wool and hides, and Europe wants also the wheat and meats, and she, as

well as the United States, wants to pay for them in manufactures.

It will be seen, therefore, that the products of the various sections within the canal's "sphere of influence" are of a thoroughly interchangeable character.

DOES THE CANAL REALLY SHORTEN TRADE ROUTES?

Next we must consider the relative distances via the Panama Canal and other existing routes, measured between great trading centers. From Europe we may take Liverpool as a representative point. It represents, with a fair degree of ac-

curacy, the initial point for the trade of Europe.

For the western coast of America we may consider the chief ports from Chile to Washington. For the Far East we may consider Yokohama, Shanghai, Hongkong, Manila, Sydney and Melbourne, Australia, and Wellington, New Zealand, as more or less within the "sphere of influence" of the Panama Canal, while Singapore, Colombo, and the ports of India are so much nearer to both Europe and the United States via the Suez that they need not be considered in a comparison of distances via the two routes.

Distances via Panama to Western Ports of America from Liverpool, New York, and New Orleans Respectively (in nautical miles).

Via Panama to—	From Liverpool.	From New York.	From New Orleans.	Advantage over Liverpool.	
				New York.	New Orleans.
Valparaiso	7.007	1622	4054	2.574	2 1 5 2
Iquique	7,207 6,578	4,633 4,004	4,054 3,425	2,574 2,574	3,153 3,153
Callao	5,937	3,363	2,784	2.574	3,153
Guayaquil	5,384	2.810	2,231	2,574	3,153
Acapulco	6,017		2,854	2,574	
Honolulu	0,017	3,443 6,702	6,123		3,153
San Francisco				2,574	3,153
	7,836	5,262	4,683	2,574	3,153
Portland	8,486	5,912	5.333	2.574	3,153
Port Townsend	8,606	6,032	5,453	2,574	3,153

Distances from New York, New Orleans, and Liverpool Respectively to Principal Ports of Eastern Asia and Oceania (in nautical miles)

То—	New York via Panama,	New Orleans via Panama.	Liverpool by shortest route.*
Yokohama Shanghai Hongkong Manila Melbourne	9,798 10,649 11,691 11,548 10,028	via	11,678 10,607 9,785 9,701 11,654
Sydney	9,811 8,540	1	12,235.

^{*} Via Suez, except to Wellington via Magellan Strait.

THE ADVANTAGES OF THE PANAMA ROUTE

It will be seen from the above tables (1) that both New York and New Orleans will be so much nearer to all of western America than is Liverpool that we may expect that an increasing share

of the trade of that section will fall to the lot of eastern North America, and (2) that the eastern ports of the United States will be considerably nearer to Yokohama, Melbourne, Sydney, and Wellington than is Liverpool by her shortest route, but (3) that Liverpool will be still. nearer Hongkong and Manila than either New York or New Orleans via Panama.

It may therefore be expected that while the canal will give us decided advantages in the trade with western America and increase the share which we have of that trade, we are not justified in expecting marked changes in the share which we shall get of any part of the Orient except that with Japan and Australia and New Zealand.

However, the Panama route so much shortens the distance to the western coast of America, both from eastern America and western Europe, that we may expect to see most of the trade with western America go via Panama, except perhaps in case of European commerce with the southern ports on the west coast of South America.

EFFECT OF THE CANAL ON OUR DOMESTIC
TRADE

One of the most important results of the opening of the canal will doubtless be found in its effect upon the movements of merchandise between the eastern and western sections of the United States. This trade is already very large.

While exact figures are not available, the data at hand seem to justify an estimate of about 3 million tons per annum of freight moved by rail and about a half million tons by water from the Atlantic Coast section to the Pacific Coast section, and about an equal amount from the Pacific Coast section and Hawaii to the Atlantic Coast section. The sums paid as freight charges on these 7 million tons moved between the Atlantic and Pacific Coast sections are estimated at from 250 to 300 million dollars per annum.

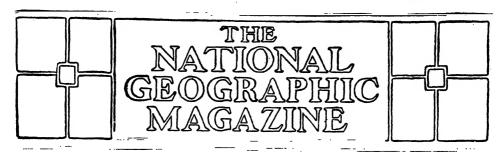
Only about one-fourth of the tonnage which now moves westward across the Rocky Mountains originates east of Buffalo and Pittsburgh, while most of the remaining three-fourths originates in the Mississippi Valley, which is the great producing section of the country and rapidly increasing its production of man-

ufactures, which are the most important factor in the west-bound traffic. Of the east-bound traffic across the Rockies, a large share originates near the Pacific coast, especially the fruits, vegetables, fish, wine, barley, and lumber; but only a part of this reaches the Atlantic coast, a considerable share being consigned to the communities of the Mississippi Valley.

At present the railway rates between the Mississippi Valley and the Pacific coast are but little if any less than for the entire distance across the continent, but this will probably be somewhat modified when the steamship rates via Panama become sufficiently low to attract the Mississippi Valley trade toward the Atlantic and Gulf ports. In the actual cost of transportation between the eastern and western sections it may be expected that there will be a marked reduction in the tonnage rates charged.

The water rates between New York and San Francisco, even with the present handicap of transferring to the Panama or Tehuantepec railways and retransferring to steamer, are from 20 to 60 per cent of those charged by the railways, and about one-third of this present water rate is paid for the transferring across the Isthmus.

To sum up, it seems probable that the Panama Canal will carry most of the freight passing between the eastern coast of the United States and the western coast of Latin-America, and that the shorter distances and lower rates which it offers will greatly increase that trade: that the trade between the eastern and western sections of the United States will be greatly increased and transported at a much lower charge per ton; that it will sufficiently shorten the distances to Japan, northern China, Australia, and New Zealand to increase steamship service and materially increase the traffic with those countries, and that the European countries will use the canal in most of their traffic with western America and in exceptional instances with northern Asia, Australia, and New Zealand.



VILLAGE LIFE IN THE HOLY LAND

By John D. Whiting

A description of the life of the present-day inhabitants of Palestine, showing how, in many cases, their customs are the same as in Bible times. Illustrated by photographs by the American Colony Photographers, Jerusalem.

ALESTINE, often called the Holy Land, is in a general way familiar to all of us from our study of the Bible. Few, however, realize that the manners and customs which prevailed there in Biblical days are still unchanged, even after an interval of 3,000 years. The land today is inhabited by three distinct classes: the *Bedouin*, or nomads, a wandering, war-loving race; the *Fellaheen*, who are the agriculturists, shepherds, and village dwellers, and the *Madaniyeh*, who live in the towns and cities and are artisans.

With the advent of civilization the townspeople are fast losing their ancient customs and quaint costumes, but the villagers adhere to both far more tenaciously. Still, no one knowing the country can fail to see that a time is not far distant when many of their interesting and long-lived habits of life will be things of the past.

THE VILLAGE HOME

The present-day villages are located, as a rule, either on the tops of hills, originally for protection, or near some spring or source of water. Many are built upon the foundations of dwellings whose origin dates back thousands of years. There does not exist a single example of a peasant village that has been founded in modern times.

With almost every village or district there are, to a greater or lesser extent, variations in the dialect of the Arabic they speak, their style of dress, and the homes they live in.

On the Plain of Sharon, where stone is rare or non-existent, the houses are made of sun-dried brick, the roofs thatched and covered with clay to shed the rain, while in the mountains they are built of stone, since of that material there is an inexhaustible supply.

Many have pictured in their minds Mary and Joseph, after arriving at the "inn" at Bethlehem and finding no room, being forced to turn into some barn built of timber, with lofty roof, hay mows, wooden mangers, and stalls for cattle and sheep. Such a stable has been the subject of many medieval and modern artists, but it does not present a really true picture. Let us consider the old-style village home that is most common in the districts around Jerusalem and Bethlehem, for that will give us a better idea of what happened on that first Christmas day.

The village streets are crooked, narrow, and unpaved. As in many of the countries of the Orient, farmers live close together for protection, and not on their lands; therefore in the villages there are no open fields or gardens, but house is next to house, except for the small walled-



MIXING THE MORTAR FOR THE ROOF

When a house is ready to roof over, all the villagers, both men and women, lend a helping hand. In this picture we see the men mixing the mortar and placing it on boards, which are passed along by the women to the men working on the roof.

in inclosures or sheepfolds through which one generally passes when going into the dwelling.

The house itself consists of one large room, usually square. The walls, from 3 to 4 feet thick, are built of blocks of stone roughly dressed and laid in mortar, roofed over with a dome, also of stone. The outside of this roof is covered with a coating of mortar made of clay, which, on being pressed with a small stone roller or pounded with a board, becomes hard and compact enough to shed the rain (see page 252).

A steep outside staircase, unprotected by any railing, is built up to the roof, for the surface must be repaired at times. The flat, open space of the roof also forms a handy place on which to dry figs and raisins, and during the hot weather the family may sleep there at night.

THE UPPER ROOM OF THE HOUSE

Entering the door, we find that about two-thirds of the space is devoted to a raised masonry platform, some 8 to 10 feet above the ground and supported by This raised space, low-domed arches. called *cl mastaby*, is the part occupied by the family, while the lower part is used for the cattle and flocks (see page 310). A few narrow stone steps lead up to the mastaby, and a couple of small windows pierce the wall, high up from the ground. These, as a rule, are the only means of admitting light and furnishing ventilation to the entire house. Until about half a century ago it was thought unsafe to build even medium-sized windows, and any man presuming to do so would have been considered as challenging the rest of the community.

On one side is an open fireplace, with a chimney running through the wall and terminating on the roof often in an old water jar whose bottom has been knocked out, and so becomes a sort of smokestack. Many houses have no chimney at all; small holes through the wall, or the windows, furnish the only exit for the smoke, which on winter days fairly fills the house.

The furniture is very simple and, as a rule, consists of a crudely decorated bridal chest in which the mother of the family has brought her trousseau; a straw mat or heavy woven woolen rug which covers part of the floor, and mattresses, with thick quilts and hard pillows, which at night are spread on the floor.

The cooking utensils are few in number—one clay cooking pot, a couple of large wooden bowls in which to knead the dough, and a couple of smaller ones used to eat from. Wheat is ground in a hand-mill of black basalt, the lower stone being imbedded in a sort of sun-dried clay troug, shaped to receive the flour as it is ground. These, with a sieve or two, a large wooden cooking spoon, a small brass coffee-pot, a few tiny coffee-cups, and perhaps a clay dish in which to roast and grind the coffee beans, comprise the entire outfit.

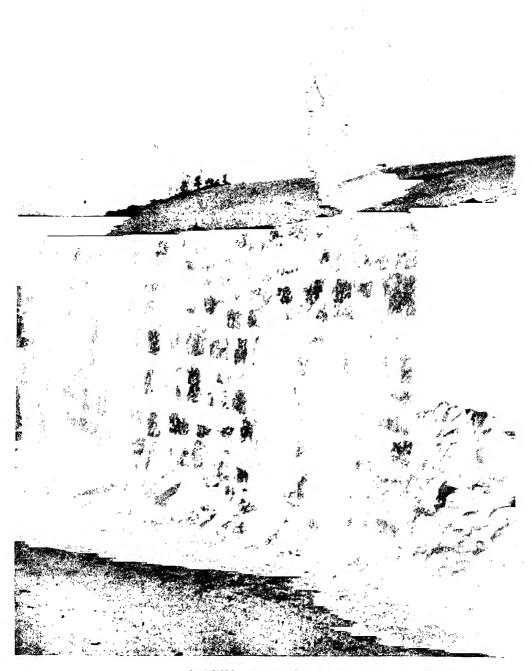
Having inspected the dwelling portion, which at once is kitchen, store-room, bedroom, and living-room, let us descend the steps into what the natives call the stable.

Below the *mastaby*, or raised platform, just described, among arches so low that a man can scarcely walk erect, are the winter quarters of the goats and sheep. To shut the flocks in, these arched entrances are obstructed with bundles of brush used as firewood for the winter. The rest of the floor space, which is open to the ceiling, is devoted to the few work cattle and perhaps a donkey or camel. Around the walls are primitive mangers for the cattle, built of rough slabs of stone placed on edge and plastered up with mortar.

Often the owner makes a small raised place on which he sleeps at night to enable him to keep better watch over the newly born lambs, lest in the crowded quarters some get crushed or trodden down by the older ones. Here he often sleeps by preference on a cold night, for he says the breath of the animals keeps him warm.

THE LAND, NOT THE PEOPLE. CONSERVES THE OLD CUSTOMS

One cannot become even tolerably acquainted with Palestine without perceiving that it is the land that has preserved the ancient customs. Its present-day inhabitants, who have nothing in common with the modern Jews who crowd Jerusa-



ROOFING A VILLAGE HOME

"The outside of the roof is covered with a coating of mortar made of clay, which, on being pressed with a small stone roller or pounded with a board, becomes hard and compact enough to shed the rain" (see page 251).

lem, are still perpetuating the life of Abraham and the customs and ways of the people who lived here at the time of Christ.

To know the heart of the land, to have learned the hospitality of its people, which is always offered, no matter how primitive or simple, makes it easy to picture Mary and Joseph returning from the inn, already filled with guests, and turning aside into a home such as we have described, the regular dwelling portion of which may have been none too large for the family which occupied it. It may have been crowded with other guests, but they find a welcome and a resting place for the babe in a manger.

Such a use of the *rowych*, or stable portion of the house, by human beings is not the exception, but an every-day occurrence. You can occasionally find men working their primitive looms there or the mother preparing the food or doing her little sewing near the door, where there is more light on a dark winter's day.

We have all perhaps noticed that in the two Gospel narratives where the birth of Jesus is dwelt upon* neither of them mentions a stable, barn, or anything equivalent, while Matthew, speaking of the wise men, says: "And when they were come into the *house*, they saw the young child with Mary his mother."

Many of these dwellings, placed as they are on ancient sites, are built over old caves or caverns which are incorporated into the lower or stable portion. Today, in Bethlehem's church, such a cave is shown as the actual birthplace of Jesus. Its walls are covered with costly tapestries and paintings, and from its ceiling hang lamps of gold and silver (see page 304).

THE GUEST-CHAMBER OF THE VILLAGE

Each village has an upper room or guest-chamber (see page 254). During the summer the shade of some large tree is often substituted for this room. However, in either case this guest-chamber or tree is the social center for all the village men, where many spend the evening or the entire day when they have nothing with which to occupy themselves. Socia-

bility is one of their characteristics; they love to gossip and chat about the local news. Of course, not a single newspaper is to be had; so all their information is derived from those who have been last to town.

A servant is hired to attend to this guest-chamber, and every day, by turn, one of the villagers furnishes the coffee beans and sugar for the coffee to be served to the men thus congregated; he, too, supplies the food and bedding if some

ordinary guests come along.

They are, of course, great respecters of persons; so that if a common man happens in, a couple of fried eggs with bread and olives will do for him. If a more important personage arrives, a pair of roast chickens is provided for his supper; but if a still more honored one, a sheik of a village, or a large company of men appear, a lamb or kid is killed, and in all cases horses are furnished with nose-bags full of barley. The supplying of these more expensive meals is apportioned among the various men by turn, while they furnish barley according to the amount of land possessed.

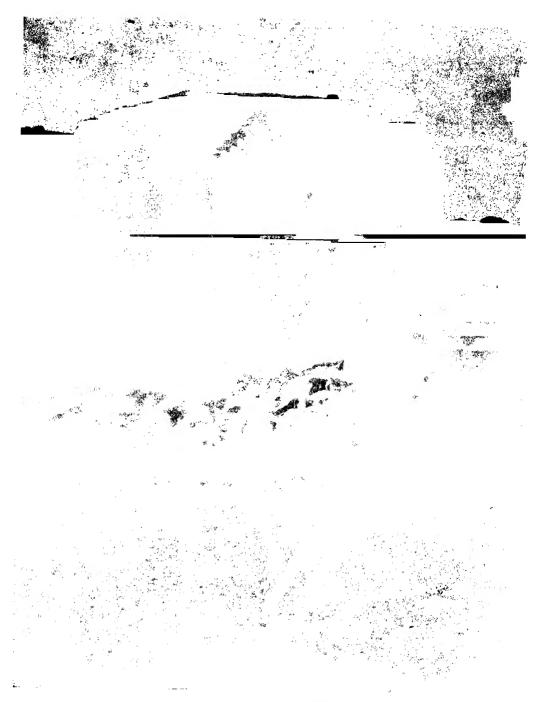
In the possession of the man attending the guest-chamber are three small wooden bows, on the cord of which are strung slips of paper, each bearing the name of one of the men of the village. The slip first in order indicates the name of the person whose turn next comes to serve, and in this simple way the proper accounts are kept, since one of the bows represents chickens, the next lambs and kids, while the third is for the barley. As each one fulfills his obligation the paper representing it is torn off, and when all are gone, a new set is written and the turns begin again.

Let us now watch a company of distinguished visitors arrive at the village

guest-chamber.

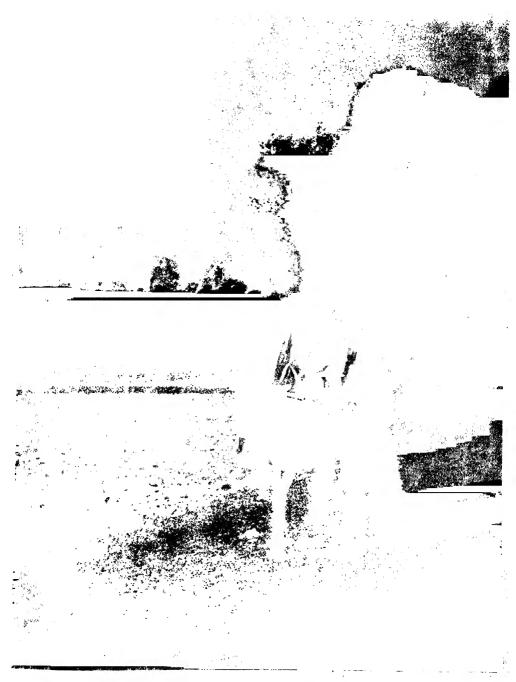
The young men run to help the guests dismount, and, leading the animals away, tie them in the courtyard or in the stable, which is below the "upper room." Others hasten to spread rugs and mats on the floor and mattresses around the wall, furnished with cushions, for on them the guests sit cross-legged or recline. Many of the men of the village now join the

^{*} Matt. 2: I-I2; Luke 2: I-20.



THE VILLAGE GUEST-CHAMBER

"Each village has an upper room, or guest-chamber. During the summer the villagers often substitute the shade of some large tree for this room. This guest-chamber or tree is the gathering place for all the village men, where many spend the evening or the entire day when they have nothing with which to occupy themselves, for sociability is one of their characteristics" (see page 253).



THERE ARE NO SUFFRAGETTES HERE

The proper etiquette of the Holy Land bids the wife follow meekly on foot while her husband rides majestically in front. In the good old days the gentle sex never was seen riding, but the modern spirit is creeping in, and "today it is a common sight to find a woman astride of a donkey" (see text, page 261).



The Samaritan woman wears the bloomers of the North under the loose long robe, or tobe, of the South, her costume emphasizing her geographical position. The graceful carriage of the Syrian woman is due to her custom of bearing heavy loads upon her head

guests, and for a while there are long exchanges of salutations, while tiny cups of coffee are sipped, and the more they enjoy it, the louder they smack their lips.

Bitter coffee is generally offered and is served with only a sip at the bottom of a very small cup, while when sweet coffee is made, the cups are filled to overflowing. This, as will be readily seen, has a symbolical meaning—"May bitterness be little and sweetness abundant."

AN INGENIOUS INSULT

Traveling with a friend some years ago, we were thus entertained. Entering the guest-chamber, we noticed that the occupants were unusually quiet and that one man had no turban on. It was whispered to us that this man, who was a stranger, had been robbed the night before by one of the men of the village who had a notoriously bad reputation, even among his own people. The victim had appealed to the elders of the town. Without a word, coffee was prepared.

As we were foreigners, they made sweet coffee for us, thinking we would not like the bitter, and filled our cups full, while the bitter kind was passed to all the rest in little doles; but to the man suspected of robbery a full cup was served. This was such an insult that he flew out of the room; a fight ensued, his house was searched and the goods recovered, and the stranger again donned his headgear, which was among the things that had been stolen.

As they thus sit chatting and drinking coffee they also smoke. Each man carries a leathern pouch of tobacco from which he rolls his own cigarettes or fills a long-tubed water-pipe or nargheli.

Little preparation is made for the midday meal. Some hot bread, a plate of fried eggs, another of curdled milk, or a dish of fresh butter with a pile of fine sugar on top, suffices. This meal is for the guests alone.

A FEAST FOR THE STRANGER

The person whose turn it is to give the supper does not start preparations till the flocks come home in the evening, when a fatling is slain, cut into pieces, and boiled as a stew in a great kettle. Another large pot of rice is cooked.

All the men of the village now slowly congregate at the guest-chamber, each throwing down on the coat, spread for this purpose, a couple of thin loaves of bread that he has brought with him.

When all are assembled, the pile of bread is torn up into small pieces and placed in large wooden bowls. Over this, in each bowl, a large pile of rice is put and the meat on top, while a liberal supply of the gravy is added.

Sitting on the floor, first the guests, with the older and more important men, fall into circles around the bowls, and before partaking each one says *Bismallah* (in the name of Allah), to drive away the genii. With the aid of the thumb and first two fingers, great balls of rice and soaked bread are made, which are dexterously popped into the mouth.

The food is eaten very hot, and it is surprising how much one man can consume when at such a feast and how little it takes to sustain him ordinarily.

As each set finishes eating they wash their hands, water being poured on them by a servant, as we read of in Old Testament times.* Then they drink coffee and smoke until time to retire, when beds are spread on the floor for the guests, some of the villagers remaining with them, sleeping in their coats. The party usually leaves the village early the next morning.

The guest-chambers are not for women; so, if a man is traveling with his family, he does not go to this regular reception place, but waits about the village until some one passing invites him into his house. This happens today just as in the case of the Levite of old who was traveling with his concubine and servant from Bethlehem-judah, and was entertained at Gibeah by the old man from Mount Ephraim who found them waiting in the street of the city.

CONCERNING FAMILY LIFE

Children in the peasant family are always welcome, girl babies sometimes excepted. The father prides himself on his boys, and even the mother prefers them, and, when questioned as to the number of her offspring, she will invariably say

^{* 2} Kings 3: 11.

[†] Judges 19: 15-21.

that she has five children and two girls, or as many as the case may be.

Not to have a boy is a great hardship to the family and is especially felt by the mother, for failure to have a son may become the cause of her divorce or her husband's excuse for marrying again. This feeling is hard to understand, since they look upon a girl as a profitable possession, for a would-be husband must pay a comparatively handsome price for her. The boy, on the other hand, is a greater expense, and his wife and wedding are costly affairs. The only explanation is that their great aim in life is to perpetuate the name of the father.

To be polite the *fellah*, in speaking of a pig, dog, donkey, or anything out of good taste, invariably says, b'eed 'annak, meaning, "Be it far from you!" So, also, when a girl or woman is spoken of, they often say, "Be it far from you!"

Although women are thus looked upon as something inferior, still when they have become well advanced in years and are perhaps the grandmothers of large families, or have signalized themselves by some special attainment, they are frequently the object of the respect and reverence of the younger women and of the men as well (see page 265).

The woman may never call her husband by his first name, but "O father of Ahmed," or whatever the eldest son's name may be, which indeed is the name by which he is generally known.

In naming the first son it is customary to give him the name of his grandfather on the father's side; therefore, even before a youth is married he will often be addressed as the father of Ali, or Mohammed, or Suleiman, as the case may be. The first daughter is usually named for the grandmother, again on the father's side.

The wife likewise takes the name of her first-born son. The husband, speaking of her, especially to men, will never say "my wife" or mention her first name, but will say either "the mother of Ahmed," or "my family," "the relative in my house," "the forbidden," or "the daughter of my uncle."

The reason for this is that a man marries his first cousin in preference to any one else, and in fact she cannot marry another if he wants her. Gauged by our conception of the subject, the women are rigorously ruled by the men; still the men feel that in these days the women are becoming too independent, as what follows will illustrate.

ESSA'S LAMENTATION

Only yesterday Essa, who tends the vineyard of a friend near the village of Sharafat, lying between Jerusalem and Bethlehem, was heard thus complaining to another:

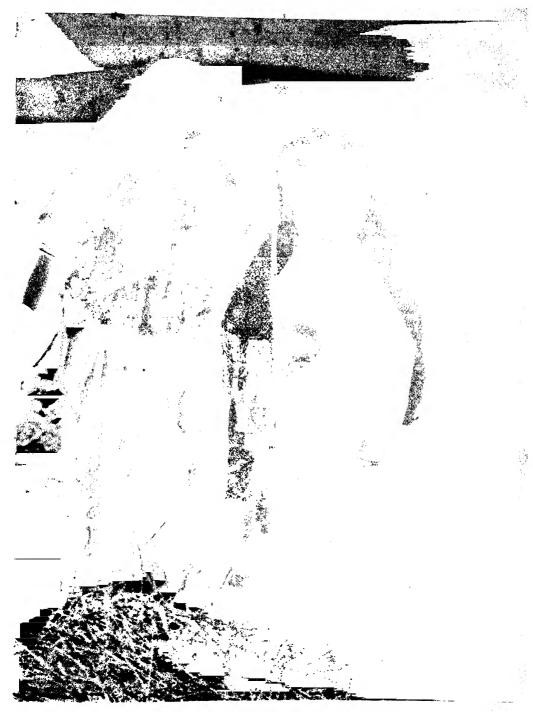
"Oh! my master, when I was young I used to rule 'my family' with a hard heart, for her ways did not please my mother, and I used to beat her much. My father, may God have mercy upon him,* often said to me: 'My son, these are the days of women, and if you so treat your wife you will not be able to live with any woman. Their ways are perverse, but you cannot change them. The days of men are passed.'

"In former days, my master, a woman would not dare to go to her father's house or that of a neighbor for a visit without first getting her husband's consent, and much less would she think of addressing her husband before people. If he happened to be in the village guestchamber with the men and she desired to call him, she would say to some man sitting by, 'Tell him to come,' and sometimes, to amuse ourselves, the man would inquire, 'Who?'; to which she would repeatedly answer only, 'he,' for modesty would prevent her mentioning his name or saying 'my husband'; but now my woman calls me 'Essa' in the midst of the village and I hold my peace.

"Women formerly, when passing men on the road, would cover their faces with their hands and keep their eyes on the ground; but now when we meet them they are not shy, so we men keep our eyes on the ground until they have passed.

"A common saying among the women used to be, 'O Preserver, protect me from my husband's displeasure!" Now

*This expression is always used when speaking of a deceased relative or friend, while when mentioning an enemy or evil person they say, "May God not have mercy upon him!"



MARRIED AND SINGLE IN THE HEBRON DISTRICT

It is a very simple matter to tell if a woman is married or single in the neighborhood of the ancient city of Hebron. All the unmarried girls wear a large silver coin on their foreheads, like the girl in the picture. When no such coin appears, it is a sign that the woman is or has been married.

AN UNUSUAL SIGHT

From time immemorial the task of furnishing the village with water has fallen to the lot of the women, who can be seen morning and evening returning from the stream or well with their water-pots on their heads. In exceptional instances the men bring the water on the backs of donkeys and camels, as shown in the picture.

it is reversed and we men say, 'O Preserver, protect me from my wife's displeasure!' Women never in former times were seen riding, but today it is a common sight to find a woman astride of a donkey, and the other day I met one so mounted, and she was even singing aloud until she caught sight of me."

THE BIRTH OF THE BABY

When the *fellah* or peasant child is born, its tender skin, without being washed, is rubbed with olive oil and salt. For seven consecutive days it is re-oiled, and when a week old gets its first bath and is again oiled, and each week until it is forty days old the bath is repeated. In some localities they consider it unsafe to bathe it before it is forty days old.

Into the little eyes they put drops of liquid tar, and when two days old begin the periodical application of *kold*. This is a dye used to blacken the eyelids of not only babies, but of women and sometimes also men, and is considered both beautifying and beneficial to the eyesight. They believe the tar to be a preventive of weak eyes, and that a child who has not been salted will develop into a weakling.

How old a custom this salting is can be seen from Ezekiel's reproachful words to Jerusalem: "And as for thy nativity, in the day thou wast born . . . thou wast not salted at all, nor swaddled at all." *

Swaddling clothes like those of Bible times† are still in use. A small shirt is the only real garment put on, around which may be wrapped some old rags, care being taken to keep the arms tightly pressed against the sides.

A cap, perhaps decorated with a blue bead or some charm to keep off spirits and the evil eye, completes the apparel (see page 314).

When one looks at a child, before admiring it or speaking of it, in order to avert a calamity, one must say *Bismallah* (in the name of Allah), or "May Allah encircle you!" or "May the evil eye be frustrated!"

Mortality among the babies is great and is not to be wondered at, for in view

of the rough treatment they receive, it becomes a question of the survival of the fittest.

HOW THE BABY IS CARRIED

In the Judean mountain districts a cradle is often kept for the baby while at home, and a sort of small hammock is used to carry the child around in when out-of-doors. The mother when going to work in the fields will be found with this hammock, called 'iiddil in Arabic, on her back suspended by a rope which passes across her forehead, often with nothing indicating that life is in it except an occasional squeal from one end.

It is a common sight when passing through the bazars to find a baby in this sling hung on a small nail or on the lock or bolt of a turned-back shop door, while the mother sits in the street behind the basket of produce she is selling, seemingly unmindful of her child's hazardous position.

When in the fields she erects a tripod of sticks, from which she suspends the hammock, and she protects it from the rays of the sun by covering it with one of her garments.

In the Samaria district and along the plain of Sharon a crudely decorated wooden cradle is the fashion and is carried by the mother on her head wherever she goes.

We cannot refrain from narrating a story heard from an eyewitness.

THE GENII CAPTURE A BABY. A TRUE STORY

A woman of Abou Shoushey, waking up late one morning and picking up the cradle in haste, started off for the baryest fields.

She had no more than entered the narrow path between the stretches of standing grain when she felt her babe leap from the cradle on her head and heard it glide rapidly through the wheat.

Terror - stricken and trembling, she screamed for help, calling to the men to pursue the genii that had taken her babe.

‡ Abou Shoushey is ancient Gezer, which was given by Pharaoh as a dowry to his daughter when she married King Solomon.

^{*} Ezekiel 16:4.

[†] Luke 2:7.

After a heated chase some returned to inquire further particulars of her.

Unable to get a reply, for she still stood screaming, "The genii have taken my boy!" they lowered the cradle from her head and found the child still sound asleep.

The others soon returned to say they had overtaken the supposed enemy, only to find that it was her domestic cat, which had jumped from its hiding place near the behavior

the baby.

HE HAD THREE DAUGHTERS BUT NO CHILDREN

Essa met us at the gate one evening and his face showed that something out of the ordinary had occurred. After the usual salutations he said, "I come to you for the reward of good news."

"And what is it?"

"My family gave birth to a baby."

"Imbarak" (May it be a blessing!); to which came his reply, "Imbarak feek" (A blessing by your presence!).

"What is it, Essa?" He hung his head and replied, "Be it far from you, a girl."

"How many children does this make?" he was asked. Essa looked embarrassed, and said, "I have no children; this is my third girl. When I went into the village this morning both women and men said to me, 'Imbarak, Essa! May it be granted that she die!' but I replied, 'May Allah not listen to you!' for I have become like you foreigners and I am satisfied, although I had taken upon me certain vows in case it was a boy."

THE COSTUMES OF THE WOMEN

The costumes of the women differ sufficiently in each district to enable one to distinguish readily where the wearer comes from. From the variations of the headgear one can tell whether a woman be single or married; but, although differing from one another in the details, the costumes have much in common.

The dress, called a tobe, is like a long loose shirt, the sleeves narrow at the shoulders and widening out something like the Japanese pattern. The front and back are made each of one width of cloth, with a gore on each side to widen the

skirt. A girdle either of white linen or bright striped silk is wound around the waist and the *tobe* is pulled up a little to produce a full bosom.

This *tobe*, when for common use, is of dark-blue cloth, the bosom is covered with cross-stitch embroidery and perhaps a little on the sleeves and skirt.

In the districts north of Jerusalem the *tobe* for the bride or for gala occasions is made of heavy white linen almost covered with embroidery, the prevailing colors being dark green and red with a little orange mixed in (see page 307). Around Samaria the *tobe* is made of white cotton cloth in which are woven bright strips of red, yellow, and green.

The shoes are crude affairs, the tops being of bright red or sometimes yellow sheepskin, with soles of raw cow, camel,

or buffalo hide.

WEARING HER DOWRY ON HER HEAD

The headgear is of two parts: first, what we shall for convenience sake call a cap, and over it a veil. The Bethlehem women wear a high cap, in shape something like a man's fcz, called shatweh, on the front of which are sewn rows of gold and silver coins.

A woman never parts with the coins from her headgear except in dire circumstances, and for her to admit that she has lost one of these is considered a great shame, for an evil meaning is put upon it. This throws a strong light upon the parable of the woman who lost one of her ten pieces of silver.*

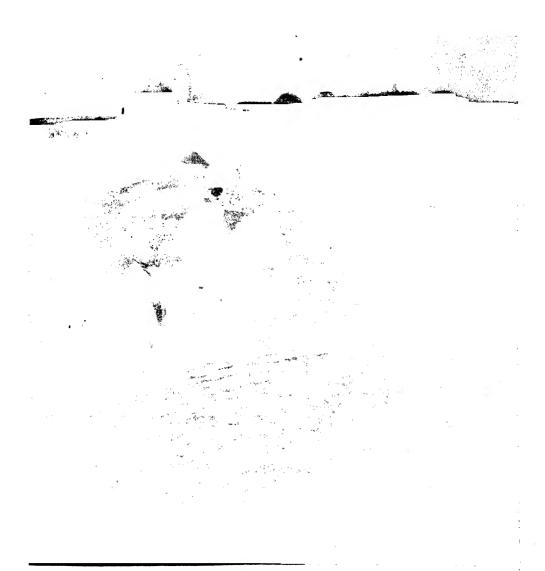
The woman in the Gospel had not lost a piece of money merely valuable as a medium of exchange, but a part of her ornament and dowry, and had thus brought a reflection upon her character. So it was vital for her to recover it.

No wonder, then, she is pictured as lighting a candle, sweeping the house, and seeking diligently until she finds it, and then calling her friends and neighbors to rejoice with her.

THE CAPACIOUS, USEFUL VEIL

The veil is a large affair, some 6 feet long and 4 feet wide, and placed over the

* Luke 15:8, 9.



THE TOMB OF MOSES

This photograph shows peasants, town folk, and Bedouins assembled at the traditional site of the Tomb of Moses. Pilgrimages to this spot are quite popular, for among the Moslems the "Prophet Moses," as they call him, is held in high honor.

cap it covers the entire headgear, except the coins in front. It is considered improper for women to have their head or hair showing in public. At home they

put off the veil.

Ordinary veils are made of heavy white linen, with sometimes a little embroidery, while in the districts north of Jerusalem each girl makes one almost covered with needlework, so that it will match the white embroidered tobe for her wedding (see page 307).

Whenever a woman lacks a basket or bag, the veil comes into use. She places what she has to carry in one end of her veil, gathers and ties it around with one corner, and places the burden on top of

her head.

The story of Ruth, when Boaz says to her, "Bring the veil that thou hast upon thee, and hold it; and when she held it, he measured six measures of barley, and laid it on her: and she went into the city,"* clearly shows that this use of the veil is the survival of a very ancient practice.

Those not acquainted with this land of ancient customs may find themselves unable to understand how Ruth's veil could contain so much grain, because of their having in mind a veil of gauze and of small dimensions. The khirka, as the veil is called, is not only large and strong enough for this work, but such usage is very common down to the present day.

Nor is it only the veil that has survived, but the entire costume. Ezekiel the Prophet gives us a matchless description of the woman's attire of his day when, speaking allegorically of Jerusa-

lem, he says:

"I clothed thee also with broidered work, and shod thee with badgers' skin, and I girded thee about with fine linen, and I covered thee with silk. I decked thee also with ornaments, and I put bracelets upon thy hands, and a chain on thy neck. And I put a jewel on thy forehead, and earrings in thine ears, and a beautiful crown upon thine head. Thus wast thou decked with gold and silver; and thy raiment was of fine linen, and silk, and broidered work." †

* Ruth 3: 15.

THE JEWELS OF BIBLE TIMES AND OF

Jewelry is very much prized, although it is mainly confined to heavy silver pieces.

A heavy silver chain is attached to the cap on either side and hangs down about the neck and below the chin (see page 307). A collarette made of plaited silver wire with many chains hanging from it used to be extensively worn by Bethlehem women, but is fast disappearing.

In the Hebron district the unmarried girls wear a large silver coin on their forehead (see page 259). Earrings are used and silver finger-rings, with Mecca stones or glass imitations, are much

prized.

Were we living much later we would find it difficult to learn the meaning of the prophet's word, "And I put . . . a beautiful crown upon thy head." The tasseh, a disk of wrought silver or gold which, according to the old men, used to be so common, and was worn by the women sewed to the crowns of their caps, is today almost non-existent. They can occasionally be picked up at the silversmith's, where they have been sold for the silver that is in them, but the present writer has not seen a single one in use among the peasants.

In the Nazareth district European material is fast displacing hand-made goods. Even around Jerusalem the women are taking to shawls of foreign manufacture in place of the handsome hand-embroidered veils whose colors harmonize, which cannot be said of these shawls, with their flaming roses and pink backgrounds.

Few of these peasant women can be said to be handsome; still, they make an interesting and picturesque sight, as they walk in companies along the roads, going to town with their baskets of produce, or returning, chattering like magpies over the day's transactions.

When the road is very stony or wet, it is a common custom for them to take off their shoes to save them, placing them on top of their loaded baskets (see page 306). It takes *metaliks* (coppers) to mend shoes, but feet mend themselves.

The Bethlehem women have the repu-

[†] Ezekiel 16: 10-13.

tation of being handsome. Their faces are a full oval, their complexion fairer than the ordinary fellaheen, often having very red cheeks, and attractive in the setting of their striking headgear. Their Nazareth sisters have gained a little less Both are Christians and suprenown. posed to have a considerable strain of Crusader blood in their veins.

THE ATTIRE OF THE MEN

The clothing worn by the men is very varied, and so we will consider only the most typical. There is a long shirt made of white cotton cloth, also called a tobe, and in form much like the women's. Over this is a sort of gabardine made of striped goods, the waist being girt about with a leather, wool, or silk girdle. The colors are quite bright, red and yellow or black and yellow being favorites.

The headgear costs him, like the woman's with its silver attached, more than all the rest of his outfit. A low domelike fez, with a blue silk tassel, is wound round with a turban (see page 313).

This turban indicates where he comes from or his class. In the district north of Jerusalem the turban consists of a large square of white linen, with a colored border woven in; around Hebron it is of silk, golden yellow and red.

A plain white one denotes a man of letters; a plain red, that he is a dervish or holy man, and a plain green again, that he claims to be a direct descendant of Mohammed. Inside this fez is a heavy felt cap, and often between them one or two old fezzes are found, while next to the head there is still another cap of white cotton cloth. The object of these many layers is to make the headgear heavy, which is commonly believed to prevent headache.

Similarly the women with their heavily weighted caps do not remove them night or day. Between the layers of the turban the man stows away his snuff-box, jackknife, often a large pack needle, sometimes money and valuable papers if he has any. They have a witty saying to the effect that if one lacks a place of safekeeping let him make his head his

custodian.

Little boys are dressed like the men, with the exception that they have no turban until about 12 years old, and when his father gives a boy his first he feels just as proud and important as any American boy over his first long pants.

The men shave their heads clean, leaving only a central topknot of long hair, and to shave the beard, once it has been allowed to grow, is considered a great disgrace. To swear by one's own beard, or the beard of the one with whom the controversy is being waged, is the usual thing, as well as bringing in that of the Prophet to add weight.

The trick of shaving off half the beard of an opponent as a sign of contempt is practiced even today among the peasants exactly as it was in the days of King David when he sent his servants to Hanun, king of Ammon.*

AN OVERCOAT, CARRY-ALL, AND BED-CLOTHES COMBINED

The top garment or overcoat of the fellah is of coarse, woolen cloth woven in broad stripes of black and white or dark blue and white. In some districts the men do the spinning themselves in their spare time (see page 313), take the yarn to the village weaver to be converted into cloth, and then the women sew them.

This coat is as simple in form as it is possible to be. It is nearly square and in length extends a little below the knees, is open down the front, and has an opening in each upper corner to pass the arms through. The best of them are made of only one piece of cloth, the width of which is the length of the coat, so that the only seams required are along the shoulders.

Such a garment undoubtedly was the "coat" over which at the crucifixion the Roman soldiers "cast lots" rather than "rend it," for it "was without seam woven from the top throughout." †

It serves as a kind of carry-all, the wearer carrying various things in it; on rainy days it is pulled up over the head and sheds the rain fairly well, and at night it is the covering in which he sleeps.

It is strange how fond both men and women are of keeping their heads well wrapped up in cold and wet weather, both when walking and sleeping, while

^{* 2} Samuel 10: 4-5.

[†] John 19: 23-24.

the feet and legs can be quite bare and exposed to the cold and wet with seem-

ingly but little discomfort.

When the native men travel and night overtakes them far from a village, they lie down in an open field or by the road-side, thrust the head into one corner of the abayeh, and, wrapping it round the body, have little care whether the legs be bare or not. It is quite common to see men thus sleeping with a stone for a pillow, just as Jacob did of old at Bethel.*

In the Mosaic law we read: "If thou at all take thy neighbor's raiment to pledge, thou shalt deliver it unto him by that the sun goeth down: for that is his covering only; it is his raiment for his skin: wherein shall he sleep?" † Today the giving of small articles as a pledge or security is quite common; still, any one taking an abayeh from a poor man to deprive him of it over night is considered as unmerciful and a kind of Shylock.

THE OLDEST EXISTING TYPE OF HEAD-DRESS

In some districts or villages the men wear the Bedouin headgear, consisting of a large square of cloth called kaffeych. It is doubled cornerwise, laid on the head, and held in place by an 'agal, a thick double coil made of wool or goats' hair and black in color. The variations of this 'agal, or coil, show from where the person comes (see page 271).

It is probable that this form of headgear is the oldest of those now in use in the country. A small Canaanitish figure in pottery, dating back to about the 14th century B. C., now in the Whiting collection at Yale, although of necessity very crude, has such a band around the head, and shows how very ancient is the origin

of this kaffeyeh and 'agal.

Among certain Bedouin, at the death of a woman these 'agals' are removed from the head and placed on the corpse as it is being carried from the tent to the grave; and in the Book of Ezekiel a "tire" is twice mentioned‡ as part of a man's headgear, and he was told by God that his wife was about to be taken away with a stroke; but he was not to mourn or weep, but to "bind the tire of his head

upon him." This leads us to suppose that the "tire" of that time must have been the same in principle as the present-day 'agal.

THE MARRIAGE CUSTOMS OF THE HOLY LAND

The villagers of Palestine are mostly of the Mohammedan faith, while fewer in number are the Christians belonging to the Catholic and Greek Orthodox churches. Some villages are entirely Christian, and there are a few which have both religions represented, but in this case each class has its own quarter.

We are, throughout these descriptions of the life of the present inhabitants of the Holy Land, devoting our observations to the Mohammedans, who are not only by far the most numerous, but also, from our standpoint, the more interesting, as they follow the ancient customs more closely than the Christians.

Marriage takes place at an early age, the young men at about 20 and the girls between 12 and 16. So long as the father is living, the burden and expenses of marrying his sons fall on his shoulders.

When a youth has reached a marriageable age and the expenses that a wedding involves can be defrayed, he begins in a business-like manner to look for a bride. When his choice seems to rest upon a certain girl from simply seeing her in the village, for no courtship is allowed, or if a girl is heard of in another hamlet that strikes his fancy, then the mother of the bridegroom, with a retinue of her daughters and women friends, goes to see the prospective bride.

If she is from another village, they may spend a couple of days "looking her over," as the expression is, learning whether she bakes well and is handy at all kinds of work, seeing if she is good looking, and, above all, that her eyes are perfect. One who, like Leah of old, is "tender-eyed," is but little sought after.

FIXING THE PRICE OF THE BRIDE

The young man, with his father, uncles, and other male relatives and friends, next makes a visit. They formally ask for the girl's hand. It would be considered impolite for the girl's father to meet the

^{*} Genesis 28: 11. † Exodus 22: 26, 27.

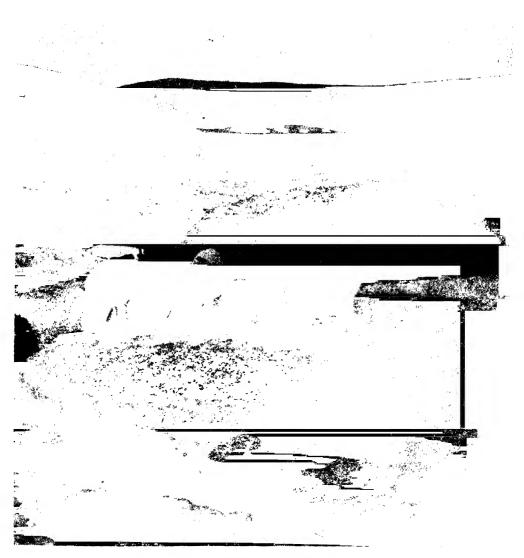
[‡] Ezekiel 24: 17, 23.

[§] Genesis 29: 17.



THE ROAD TO JERICHO

The two Bedouins in the foreground are wearing their characteristic head-dress, the white cloth and double coil of goats' hair. This is reputed to be one of the oldest known forms of headgear still in use and has been traced back to the fourteenth century before Christ (see page 270).



TREADING OUT THE GRAIN

"Threshing by the primitive methods employed is the most tiresome task of all the fellah's round of toil. In many places it is done entirely by treading out beneath the feet of the animals, which are tied together abreast and driven round and round over the spread-out grain. The mules and horses are provided with flat sheet-iron shoes for all kinds of work, and the cattle, just as the threshing season begins, are specially shod" (see page 281).

request with a refusal, for if he objects to this suitor, he will not agree to the amount to be paid for her. The groom's father then offers for the bride a sum far in excess of what he really expects to give, thereby exhibiting his generosity; but this is only byplay.

Different men present urge that for their sakes the price be lessened by a certain sum, and so on until the amount is brought down to what the bride is actually known to be worth—that is, to about the habitual price. This offer being finally accepted by the father of the girl and the details of the betrothal contract arranged, the kid or lamb which the visiting party has brought with them is killed and dressed.

As these preparations are in progress, and others drop in from the village, the bridegroom or his father will rehearse the contract with the bride's father over again, so that several witnesses may hear the terms agreed upon in case of a dispute arising later. The bride has nothing to say in the matter; she is not consulted.

WHAT A BRIDE IS WORTH

The price of a bride depends on her age, beauty, usefulness, and the family to which she belongs. The daughter of an influential sheik is greatly sought after and will bring many times the price given for even superior girls from families of less importance.

The prices range in sums which represent in American money from \$100 to \$400, besides which the minor expenses bring up the total considerably, often

doubling it.

Among these the bridegroom, according to his ability, must give a present to the guest-chamber of the bride's village, a new dress to the bride's mother, and an abaych (outer garment) to her father; and her oldest uncle on both her father's and mother's side must each receive a new garment with a gold coin in the pocket. He has also to provide two feasts, for which a man in average circumstances must furnish 15 fatlings.

Meantime the father of the bride has given her from the money paid as her price, say from \$20 to \$40, with part of

which she gets the proper coins and with them makes her first married woman's headgear. With the rest she buys a couple of pairs of bracelets, some fingerrings, and an *iznak*, or neck chain.

The balance of the money the father keeps, just as if he had sold some cattle or produce, except that it is the custom for him to give her an every-day tobe, or dress, a veil, and a mattress, pillow, and quilt.

THE BRIDE LEAVES HER NATIVE VILLAGE

From the time the trousseau is bought until the actual wedding day, a period from a week to 10 days, there will be dancing every night in the guest-chamber by the men, while the women make merry in the bridegroom's home.

When the bride belongs to another village, they go for her the day before the wedding, the company consisting of the bridegroom and his men and women relatives and a lot of his young men friends, all dressed in their best and armed with whatever weapons they may possess, and many of them mounted. They take with them several sheep or goats.

Upon reaching the village, they slaughter all the animals they have brought, and the entire village partakes of the feast. The bride is now arrayed in her new costume, puts on the married woman's cap and all her jewelry, her face is covered with a green or red gauze veil, and finally there is thrown over her entire person a man's gabardine.

She is mounted on a horse or camel, and with the firing of guns, the racing of horses, and a great send off, they leave the village, the bride's mother carrying the bridal chest along on her head, she being about the only person who goes with her, except perhaps a sister or female friend.

As the bride leaves the village she receives a gold coin of about \$2 in value from the villagers, which in fact is part of the amount paid by the groom to the guest-chamber, and each of her uncles gives her a present in money. In each village through which she passes on her way she is met and a piece of money given her.

The bridal party has now arrived at



A VILLAGE INDUSTRY

During harvest time the village women can be seen selecting fine straw from the grain piles, which they subsequently weave into straw baskets and trays. The process of manufacture is quite simple, as can be seen from the picture.



DRYING STRAW BASKETS

After the baskets have been made they are laid in the hot sun to dry. The women will then carry them long distances to market, where they sell them for an amount corresponding to five cents in American money. To the Western mind this does not seem a very great reward for labor, but they are satisfied.

the bridegroom's village, and the bride and those with her become by invitation the guests of the first house they reach, and this opportunity of entertaining them is looked upon as a distinctive honor. The host kills a fatling and prepares a feast to which only women are admitted, and here, under the protection of her mother, the bride spends her first night in her new village.

When the bride has arrived safely, messengers are sent back to invite her father and male relatives to the ensuing ceremonies, and if the groom be prominent or wealthy he calls all his friends in the surrounding country to take part in

the marriage feast.

THE WEDDING CEREMONIES

Early the next morning the wholesale slaying and cooking is begun, and a special dish is prepared for the women. During the day the religious formalities are attended to with great secrecy. bride, in the presence of two witnesses, appoints her father or nearest male relative as her representative.

The groom and the bride's representative are now seated facing each other, and a certain exact formula is thrice repeated with much punctiliousness. parties are prompted by the khatib (teacher), or the religious head of the village, who does not allow the slightest mistake to pass uncorrected. In this manner the young man accepts the bride as his wife and the representative of the girl in her stead agrees that she be his wife. At this time the marriage contract is written, which gives the names of both parties, the sum paid for the bride, with all the minor details.

The explanation of the secrecy observed while the couple is thus being married is that they believe that should an enemy be present and either spill flour on the ground or tie knots in a string a specific calamity will surely befall the newly married pair.

Toward evening the young men dress the bridegroom in his best, and with the entire village go out into some open field, where they have horse-racing and shooting (see page 309), in both of which the groom is supposed to demonstrate his skill, while the women stand by and sing.

Returning to the village, the men go to the guest-chamber and the marriage supper begins, while the women congregate at the groom's home and likewise feast. A portion is also sent to the bride and another to the family where she is a guest. The details of these customs vary, however, in each district.

When the feasting is over in the guestchamber, each guest drops a coin as a present for the groom into a handkerchief spread out for the purpose. Amid much joyous excitement a herald announces the name of each donor and the amount given, calling upon Allah to recompense

Meanwhile the women have taken the bride, with much rejoicing and merriment, from the house where she has been visiting to her new home, going either mounted as she came from her village or on the shoulders of two women, while in some localities she walks.

They dress her in her bridal attire, her arms and legs having been previously dyed with henna, the face is decorated with gold leaf, and the eyelashes and evebrows blackened with *kohl*, which to the fellah is the acme of beauty. Her head and face are finally covered with a thin The men are notified when all is ready, and with much pomp and firing of guns, they escort the groom to his house, when all retire and he alone enters.

Removing the bride's veil and wiping off the gold leaf, they stand together, while presents of money are given to the bride by her male relatives and the women, as the groom had received his previously. The husband begins by giving his first. No men are admitted except the male relatives of the bride, and they only long enough to present the bride with their gifts.

For the first few days the bride keeps on her finery and does no work; but this luxury and immunity she does not long enjoy, for we soon find her at the regular hard work which falls to the woman's

lot.

AGRICULTURE IN THE HOLY LAND

In the mountain districts the farm land is usually owned by peasant proprietors. each man's property being composed of various small pieces scattered about near



GATHERING FUEL

"After the day's baking, the woman adds as fuel some dried manure or stubble, which ignites from the hot ashes and keeps smouldering, and so heats the oven for the next day's baking" (see page 291).



WHERE THE RAVENS FED ELIJAH

In a deep ravine a few miles east of Jerusalem runs the brook Cherith, alongside of which Elijah was fed by the ravens (1 Kings 17:5). The picture shows the brook as it turns the corner under the convent of St. George.

the village in which he lives. The raising of olives, grapes, and many other fruits is the leading occupation, but almost every farmer grows some grain.

Down on the plains larger fields exist and cereals are largely planted. The land of a given village is frequently owned in common by the villagers, and a division of it takes place every year or every alternate year, and is so arranged that each man gets portions of the good as well as of the less desirable land.

Fences, in the western sense of the word, are unknown. In the mountainous country lands are inclosed by loose stone walls, still called by the ancient Hebrew name jcdar, and on the plains by thorn hedges. When the open fields are owned individually, the boundary lines are indicated by deep furrows, in which at intervals stones are laid as "landmarks." It is therefore readily seen how easily these boundaries could be changed by an avaricious neighbor, undeterred by the Mosaic warning, "Cursed be he that removeth his neighbor's landmark." *

LAND STILL SOLD BY THE "YOKE" AND "REED"

Until a comparatively short time ago real estate was bought and sold by the use of a contract, which the chief men of the place witnessed and sealed; nor has this custom become entirely obsolete. Farming land is estimated by the faddan, which, being literally translated, is "yoke," but implies a piece of land "that a yoke of oxen might plow" in a day. pare 1 Samuel 14: 14.) City property, on the other hand, is measured by a standard known as a "reed." We can trace its use far back into ancient times in the writings of Ezekiel and St. John.

PLOWING AND PLANTING

Rain! begins to fall about November, after a rainless summer, and as soon as the ground is well moistened the fellah starts planting the winter cereals-wheat, barley, lentils, beans, etc. The plow is a crude affair, made of oak, the bent parts being natural curves held together with iron bands; these bands and a small plow-

share, which only scratches the ground a few inches deep, are the only metal parts.

Oxen are the favorite animals for yoking to a plow. Cows and donkeys are employed by the poorer people. Horses, mules, and camels (the latter only along the Mediterranean coast, are harnessed singly to plows, while sometimes one sees an ox and camel yoked together. In the Bible the command was "Thou shalt not plow with an ox and ass together." §

The fellah sows the grain on the bare ground and then plows it in. In rocky ground a man or woman follows with a pick to loosen the earth in the spots that may have been skipped by the plow. The soil is not fertilized. The disintegration of the underlying limestone feeds the soil, so that for thousands of years it has continued yielding crops.

The manure and rubbish, instead of being utilized, are allowed to accumulate in heaps outside the villages until they surround it like small mountains. Immediately a house is deserted and the roof falls in the women find it more convenient to dump their rubbish there than to go farther, and in a short time the ruined house becomes a dunghill.¶

After the winter crops have all been planted the vineyards and olive groves are plowed a couple of times and also the fields reserved for the summer planting. These latter crops are not put into the ground until the rains have entirely ceased.

Watermelons and muskmelons, tomatoes, a species of cucumber, vegetable marrow, are all raised without a drop of rain or of water by irrigation, but are sustained by the moisture stored in the ground from the winter rains, aided by the copious summer dews. The natives consider that rain falling after the summer crops have been planted is extremely detrimental to them.

During harvest time the fields are lively and picturesque; the entire family has a part in the work, the small children playing about among the sheaves, and even the babies are brought to the fields.

A large toothed sickle is employed by the reapers when the grain is long, but

[†] Ezekiel, 40th to 42d chaps.; Rev. 21:15, 16. ‡ The annual average rainfall for the past 50 years has been 26 inches.

[§] Deut. 22: 10. Ëzra 6: 11; Daniel 3: 29.



THE SHEPHERD'S SLING

"With this he becomes expert in throwing stones to a great distance and with great precision. With such a simple weapon . . . the stripling David . . . encountered Goliath and slew him" (see page 295).

if short a smaller one is used, the edge being quite dull; so that it does not cut, but simply uproots the grain. Sheepskin aprons and a large glove are often worn by the men harvesters; but the women, who are doing the very same work as the men, are provided with neither.

Destitute women and girls are allowed to follow the reapers and glean the fallen ears, which they tie into neat little bundles, dropping them on the ground as they go along, and these they gather up every evening and beat out the grain with a stick, just as Ruth did of old in the

fields of Bethlehem.*

During the reaping period what the Bible calls "parched corn" is made in almost every field. Some wheat not fully ripe is cut down and set on fire, the straw only being consumed. The roasted heads are rubbed between the hands and the chaff winnowed out in the wind. Without further preparation, this roasted wheat forms one of the common articles of diet of the reapers. Undoubtedly such was the "parched corn" which Boaz reached to Ruth.†

THE THRESHING-FLOOR

A large flat rock in the mountainous country or a hard piece of ground on the plains is selected for the threshing-floor, and this, up to the present time, bears the Biblical name *jorcn*. Here all the grain

is gathered.

We read that Jacob, after his dream at Bethel, promised to God one-tenth of all he should receive. Later, when this land was possessed by the Israelites, they were enjoined to give a tenth of their produce to the Levites. We also find Samuel telling Israel what they could expect if they were determined to have a king to reign over them, saying: "He [the king] will take the tenth of your seed, and of your vineyards, . . . and he will take the tenth of your sheep."

Nor does this custom ever seem to have ceased, for the tithe is still collected. There are numerous mosques, schools, and other religious institutions which receive it from specified properties on which

* Ruth 2: 17. † Ruth 2: 14; 1 Sam. 17: 17 and 25: 18.

it is charged, and from all other tillable land it is collected by the government, the right of exacting these taxes from each village being farmed out to the highest bidder.

The sheaves are brought to the thresh-

The sheaves are brought to the threshing floor on the backs of camels, mules, and donkeys, and in big bundles on the heads of the women, and are stacked up in the requisite number of piles. One of these is first chosen by the tax collector and has to be separately trodden out and the grain delivered to him before the rest of the work begins.

Threshing by the primitive methods employed is the most tiresome task of all the fellah's round of toil. In many places it is done entirely by treading out beneath the feet of the animals, which are tied together abreast and driven round and round over the spread-out

grain (see page 272).

The mules and horses are provided with flat sheet-iron shoes for all kinds of work, and the cattle, just as the threshing season begins, are specially shod. On each half of the cloven hoof a small iron shoe is nailed, and this not only facilitates the work of separating the grain, but prevents the animal from becoming lame.

HOW THE GRAIN IS WINNOWED

In the simple treading-out process the animals are driven around slowly over the grain, while the men, with wooden forks, keep stirring it up. When thoroughly threshed, the straw has been chopped up into short bruised bits and all is then heaped up.

To separate the grain, "the fan," which is a wooden fork, is used, the farmer waiting until the wind is blowing hard enough without being violent. Such conditions are best found in the evenings or during moonlight nights. The winnower tosses up the trampled grain into the air, and, being heavier than the straw, it falls into a heap by itself, while the fine straw separates into a neat pile a little distance away. The dust and very fine particles are completely blown away. This refuse is called *ur* by the Arabs, the original Hebrew name.

A sieve is now employed, and through this the grain is passed to take out the

[‡] Gen. 28: 22. § Lev. 27: 30. ¶ 1 Sam. 8: 15, 17.



THE SHEPHERD'S FLUTE

These simple pipes have been popular in the land for thousands of years and are doubtless similar to those used when Solomon was an "And the people piped with pipes and rejoiced with great joy, so that the earth was rent with the sound of them" (I Kings 1:40,



SUNRISE ON THE FLOCK

may wonder how the sheep are separated by their different owners when morning comes. The sheep respond to the voice of their own shepherd, but, so well do they know the individual members of the flock of which they are part, that when the morning breaks each flock gathers itself "Those unacquainted with the pastoral life of this land, who do not know the almost human relationship between the flocks and their keepers, together as a matter of habit" (see page 296). coarse stubble that is too heavy to be blown away. Sometimes a wooden shovel is used to give the grain a final winnowing. The presence of the stubble is accounted for by the fact that during harvest the grain is largely pulled up by the roots.

This fine straw is kept as fodder for the animals, for hay is unknown. The Arabic name for this is tiben, being identical with the Hebrew word which has been translated "straw," and in Bible times as now was fed to the animals or mixed into the clay when making bricks. We read in Exodus that when Pharaoh refused to give the Hebrews straw (tiben) to make bricks they were scattered throughout all the land to gather stubble instead.*

It might be interesting to note in passing that when the mounds covering the ruins of the Jericho of Joshua's time were unearthed by German explorers a few years ago the ancient bricks were found to be identical in size and texture with those made now by the inhabitants of modern Jericho, having tiben mixed in just in the same way.

THE THRESHING-FLOOR MOSQUE

In the southeast corner of Jerusalem, close by the old city walls, is an inclosure some 30 acres in extent, in which stands the far-famed Mosque of Omar. Its graceful dome, tiled exterior, and richly decorated interior, with superb mosaics and stained-glass windows of arabesque designs, make it one of the chief attractions of Jerusalem to the tourist (see pages 298 and 305).

Besides its beauty and grandeur, the past history of the site demands attention. Thither Abraham came to sacrifice on the summit of Mount Moriah his only son, Isaac.† Later King David bought the threshing-floor located on this site from Ornan, the Jebusite, and built an altar to offer sacrifice in order that the plague then raging in Israel might be stayed. "Then David said, This is the house of the Lord God. and this is the altar of the burnt offering for Israel." Although David made great preparations,

* Exodus 5:12.

the actual building of the temple on this spot was left to his son Solomon.

A second temple, far less grand, was

A second temple, far less grand, was erected there by the Jews after the return from captivity in Babylon, and the third and magnificent one was reconstructed and enlarged by Herod.

After the complete destruction of Jerusalem in A. D. 70, Hadrian erected here, a temple to Jupiter. Between this and the time that the present mosque was built by Abd el Melik, little is known of

the history of the site.

To the Moslems this mosque, erroneously attributed to the Caliph Omar, is the most sacred shrine after the Kaaba at Mecca. Under the gorgeous dome, seen only in the subdued light which filters in through matchless stained glass, is the flat rock supposed to be part of the original threshing-floor (see page 305).

THE LEGEND OF THE MOSQUE OF OMAR

The legend runs thus: Two brothers were threshing out their grain upon this floor. The older one wakes one night and sees all about him his large family of children, while his brother lies on his grain piles alone. Thus contemplating his many blessings, the abundance of the crop, his large pile of grain catches his eye, and again thinking of his bachelor brother, and wishing to add some happiness to the life of one who has no family to love and be loved by, rises and from his own pile adds a quantity to that of his brother.

After the elder brother has again fallen asleep, the younger awakes, meditates on the many bounties he should be grateful for—a full crop and health and strength—his brother and his large family attract his thoughts. He reasons that he who has no one dependent upon him could well spare some of his crop and thereby perhaps add joy to his brother's life. Unwittingly he returns to his brother's pile exactly the amount that had shortly before been taken from it, and in the morning, neither knowing what the other had done, both were surprised to find their grain undiminished.

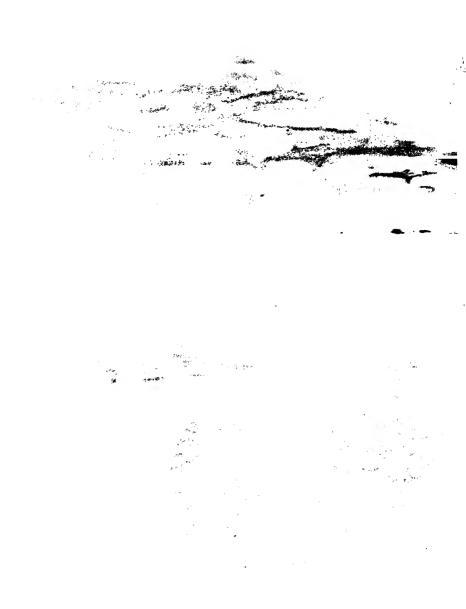
As soon as the grapes, figs, and other fruits begin ripening, the fellah, with his

[†] Gen., ch. 22. ‡1 Chron., chs. 21 and 22.



THE SMILING BUTCHER

The dweller in Jerusalem has no scientific prejudices. As long as he gets his meat, it does not worry him if the delivery is effected under conditions that would horrify an American inspector of public health.



ON THE SEA OF GALILEE: A FISHING BOAT AT SUNRISE

The Sea of Galilee, known also in Biblical times as the Sea of Tiberias, the Lake of Gennesaret, and the Sea of Chinnereth, is about 13 miles long and 7 miles broad, while it lies 700 feet below the level of the Mediterranean.

entire family, moves out of the village

into the vineyard.

The grape season is looked forward to as the best part of the year, and at this time the natives live for the most part on fruits and bread. Jokingly, the fellaheen say that they get so fat from eating grapes that their fezzes burst.

BEATING THE OLIVE TREES

A saying among the peasants likens the vine to a city woman, for it cannot stand being neglected for a single year; the fig tree to a Bedouin woman, for it can withstand about five years of neglect, and the olive tree to a *fellaha* woman, for it is still found alive after 60 years of neglect.

This simile is given to illustrate how hardy the olive tree is as compared with the fig and the vine. To an Occidental, familiar with the almost indestructible qualities of the olive, it also serves as an example of the hardiness of the women

of this sturdy mountain race.

The olives are harvested in the fall, but by a method so injurious to the trees that they yield a full crop but once in two years. Instead of picking them by hand, for time is not money with these easygoing people, they beat the trees with sticks to knock off the fruit, which at the same time results in destroying the tender shoots which should bear the next year's fruit.

When questioned, they admit the folly of this beating, but add that their fathers did so and why should they change. Evidently they are copying not only their fathers, but the Israelites before them, for we read in the Mosaic writings, "When thou beatest thine olive tree, thou shalt not go over the boughs again: it shall be for the stranger, for the father-

less, and for the widow." *

The olives when salted or pickled in brine are valued food, for a peasant can make a meal of only bread and olives, with perhaps the addition of a raw onion. The oil is a food staple, taking the place of meat. It is also, to a limited extent, burned in small clay lamps, identical in shape with those found in Canaanitish tombs, many of which were buried here before the Israelites possessed this land.

CARE OF THE POOR

A characteristic of these poor peasants is their hospitality and their kindness to the destitute.

One can any day see a party of women coming to town with their baskets for the market, and as they pass the beggars sitting by the roadside, they drop them a bit of bread or a little of the produce brought in for sale, and frequently the donor will be seemingly as poor as the receiver.

One of the prettiest, perhaps, of all Arabic words is the one for bread, namely, aish, meaning life, for with them it is veritably the "staff of life." Bread is looked upon as almost sacred, and they will never allow a crumb to fall where it will be trodden upon, and if a fragment is found dropped, perhaps by some child, on the ground it is lifted and kissed and laid up on a wall or put into a crack where some animal or fowl may find it.

The village home has near it a small hut containing the oven, called the taboon. It is a dome some 3 to 4 feet in diameter, made by the women, of clay, with an opening in the top and is provided with a cover of the same material. It stands on the ground, slightly raised by stones beneath its rim. In the bottom is a thick layer of loose pebbles. It is heated by banking up around the outside a quantity of hot ashes.

After the day's baking the woman adds as fuel some dried manure or stubble (see page 277), which ignites from the hot ashes and keeps smouldering, and so heats the oven for the next day's baking. Bread is made from soft and elastic dough. The woman brings a bowl of it to the taboon, makes a rather thin loaf by throwing a piece of the dough from hand to hand, and then flops it on to the pebbles at the bottom of the oven.

About six of these loaves fill the oven, and when baked they are full of the indentations made by the small stones. When well made and eaten warm, this bread is very good.

"THE MOTHER OF ALL TURTLES"

A story is told of a woman who refused to allow her neighbor to bake some dough in her taboon. The neighbor then

^{*} Deut. 24: 20.

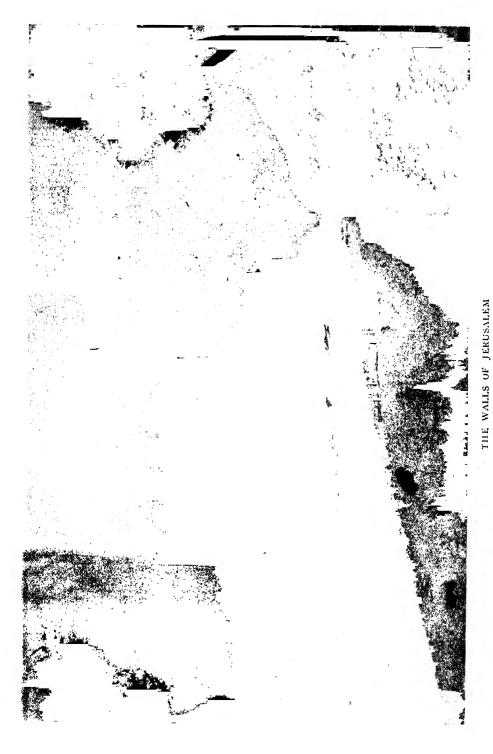


PICKING JAFFA ORANGES

Around the coast town of Jaffa are large orange groves, irrigated by water from numerous wells. Here are grown the Jaffa oranges which are world-famed for their size and flavor. Most of these oranges are shipped to England, where they are highly esteemed and bring good prices in the markets.

A QUAINT STREET RESTAURANT

The man shown here is roasting meat on iron spits over a tiny fire of charcoal. During the whole operation he is busily smoking his water-pipe, or narghile. Note the flat loaves of bread. These little restaurants are by no means uncommon in the streets of the larger cities of the Holy Land.



This is the northeast corner of the old city wall. Jerusalem was fortified by the Crusaders and later by Saladin in 1192. The fortifications were dismantled in 1219 and restored ten years later, only to be destroyed again in 1239. The present walls were built in 1542 by Suleiman the Magnificent.

begged the loan of a loaf of bread, to be returned as soon as she baked, for her oven was still too cool and her boy cry-

ing from hunger.

This was also refused, which so called down the wrath of the Almighty that an angel was sent, who, litting up the hot taboon, or oven, placed it on the back of the merciless woman, leaving only the limbs and the head protruding.

So she who thus refused bread became the mother of all turtles, and if you seem to doubt it, the *fellah* will prove it to you by calling your attention not only to the fact that the turtle's shell resembles the *taboon* in shape, but also to the markings on the top of the shell like the pebbles used in the oven.

The shells of small turtles are much in vogue as charms, by peasants and city people alike, and are often to be seen strung on a cord along with blue beads, a bit of alum, etc., and worn by the children.

A story told by a peasant living at Artas, where King Solomon had his gardens,* runs thus: A certain fellah living by the seaside was in the habit of feeding every day a loaf of bread to a whale. The chief of the genii noticed it and, addressing him, said: "For your kindheartedness you shall be rewarded. Gold and riches you can obtain by working for them, but I will give you something you cannot otherwise get. You shall have the gift of understanding the animals, but mind you do not tell any one about it."

When he returned home with his tired oxen from the day's plowing he heard the donkey say to one of the oxen, "If only you would not eat your food the master would think you were sick and would not take you out to plow."

Hearing this the man began laughing, and his wife asked the reason, but he did not tell her. The next morning, to repay the donkey for his intriguing, he hitched him to the plow instead of the ox. When he was brought back in the evening the ox asked him how he liked plowing. He pretended not to be tired, but advised the ox that if he continued not eating, the master would slaughter him.

The farmer, hearing this, laughed heartily, but would not reply to his wife's queries as to the reason of seemingly laughing at nothing. Next morning he took out the ox to plow, and the beast, fearing that the man might be leading him away to slaughter, as the donkey had said, pulled back and did not want to move. The man, knowing the reason, again began to laugh, which so aroused his wife's curiosity that she insisted if he did not tell her the cause of his amusement it was because he did not love her.

After much importuning, he at last told her the whole story, and no sooner had he done so than he lost this peculiar gift and could no longer understand the language of the animals.

HOW DAVID SLEW GOLIATH

Some experience as a shepherd befalls almost every peasant boy whose family has flocks.

As he watches over the feeding sheep, he cuts a little wool from the back of one, spins it with the aid of only a smooth pebble, and then converts the yarn into a sling such as is always carried in the scrip.

With this he becomes expert in throwing stones to a great distance and with much precision. It not only serves as a weapon of defense, but when a sheep or goat wanders off and will not return at his call he will drop a stone near it, and this at once has the desired effect.

With such a simple weapon, and a stone taken from his shepherd's bag, which was undoubtedly similar to the one above described, it will be remembered the stripling David, while still caring for his father sheep, encountered Goliath, the Philistine giant, and slew him† (see page 280).

When the owner of a flock has no son to care for the sheep, he hires a shepherd, and not only feeds him, but supplies a stipulated amount of clothing and shoes. The wages paid in money amount to only a few dollars a year.

It is not uncommon for a shepherd or a plowman thus serving a master to ceive, instead of wages, one of the man's

^{† 1} Sam. 17:40, 49.

daughters as a wife, just as Jacob contracted with Laban for his two daughters. Leah and Rachel.* The usual time served for a wife is from five to seven years.

PRIMITIVE METHODS OF DAIRYING

As long as the flocks are kept in the village, the sheep, as well as the goats, are milked by the women, and the milk turned into cheese and butter, to be sold

in the city markets.

Butter is made in a goat skin like those used for carrying water. This is only half filled with the milk, which previously has been allowed to sour. The skin is blown full of air, the opening tied up, and it is hung on a tripod of sticks and shaken back and forth by one or two women until the butter is formed (see page 312).

We have no record of how the ancient shepherds of this land made their butter, but could it have been by a cruder or more primitive process? This butter is quite white, and is not eaten, spread on bread, as with us, but is mostly converted into a cooking requisite by boiling until all the watery parts have evaporated, when it is stored in goat skins, and keeps indefinitely.

Fresh butter is also eaten served in a bowl, with usually a quantity of sugar, honey, or molasses made of grapes added,† in which each dips their morsel of bread.

During the day each shepherd pastures his flock independently, but in the evening all meet at the selected rendezvous. It may be a large open field or a spot where they are protected from the wind. Here all the flocks intermix in one great company during the night.

The shepherds arrange among themselves for a watch, each set of four or five men keeping guard for an hour or two, while the rest sleep curled up in their sheepskin. Sometimes they stand like sentinels over the sheep in the solitude of the still, starlit night, just like

the shepherds of old on the first Christmas eve.

CALLING THE SHEEP BY NAME

Those unacquainted with the pastoral life of this land, who do not know the almost human relationship between the flocks and their keepers, may wonder how the sheep are separated by their different owners when morning comes.

The sheep respond to the voice of their own shepherd, but, so well do they know the individual members of the flock of which they are part, that when the morning breaks each flock gathers itself to-gether as a matter of habit. Then the shepherds start off in different directions, each calling his own sheep, sometimes standing on a rock or elevated place, and the sheep prick up their ears and look around, and seeing their shepherd, follow him because they know his voice.

The shepherd, to make sure that none is left behind, causes his flock to pass under his rod between him and a rock, and as they pass he counts them.

As a rule, when the shepherd calls one by its name it will answer with a bleat or come running expecting a treat, as a bit of bread from his scrip or a twig of leaves broken from a tree.

Each shepherd carries a club or crook, and uses it for defense and protection and not, as in other countries, to drive the sheep with, for here the shepherd always precedes the flock and they follow In case of danger, such as the intrusion of some wild animal, the sheep rush to him, and this weapon on his shoulder seems to allay their fears, reminding one of the words, "Thy rod and thy staff they comfort me." §

To know these shepherds is to understand how the Shepherd Psalmist and King, contemplating all the incidents and vicissitudes of his pastoral life, could compose that matchless psalm, of such solace and strength, "The Lord is my shepherd, I shall not want."

‡ Lev. 27 : 32.

^{*} Gen. 29: 15-29. † Isaiah 7: 15, 22.

[§] Psalm 23:4. ¶ Psalm 23: 1.



AN ARABIAN JEW

These Jews, claiming to be of the tribe of Gad, have lived for centuries in Yemen in Southern Arabia. They are more like the present-day inhabitants of the land than any other Jews.

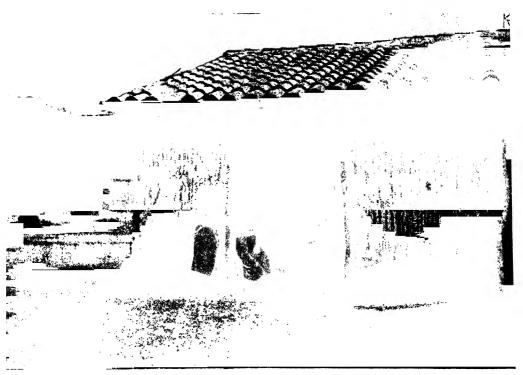
This street is peculiar in respect to the number of projecting windows.

United States has in the past 25 years, a population equal to that of the Republic of China might be saved from premature graves.

Surely such consequences challenge the support of all mankind, and call for an army of volunteers who will go out into the world and preach to the people that cleanliness is next to godliness, and if it lacks the power to produce life, it possesses the power to prolong it. Such a campaign would be fraught with enormous economic, geographic, and humanistic consequences, but it would require long years of patient work. For if we in this enlightened America, with our boasted universal education and our splendid free institutions, cannot successfully combat such barbaric and unneces-

sary diseases as tuberculosis and typhoid fever, it certainly would be too much to expect that the ignorant masses of the tropical regions would accept and live up to these preachings in a few months.

There is one redeeming feature about the governments which lie within the tropics. While in America the people order the government to do and it is done, in the tropics the government orders the people to do and it is done. Whatever else free institutions bring in the way of blessings, they do not yield the same prompt results in protecting the public health that we find when tropical governments decide to act. And therein lies the most hopeful note in the movement, now a little more than a decade old, for banishing epidemic disease from the tropics.



A MEXICAN INDIAN HOME

Photo from A. W. Cutler

Typical family of Tehuana Indians at Tehuantepec, Mexico. The sides of the hut are made of a reed and the roof is of red tile. The naked boy is very typical, as also is the pig

Prompt restrictive measures were taken, a quarantine was set up, vaccination against the disease was resorted to, and 10,000 carabao were imported from Asia to take the places of the ones the small farmers had lost. All these measures promptly served to put an end to the epidemic and the Philippines were once more safe from a live-stock famine.

With the mastery of the secrets of the tsete fly and its fatal bite on live stock, England has set out to render Africa inhabitable to horses and cattle wherever the English flag floats over it. Anthrax fever is going the same way, as is the fever caused by the cattle tick. Perhaps as much has been done in the direction of rendering the tropics habitable to our domestic animals as has been done for ourselves.

In the generations to come, there can be no doubt that with a sanitary science that is broad enough to reach both man and beast, the great plains of the highlands in the tropics will be converted into vast cattle ranches, where cattle can be brought to the stock cattle stage and then shipped to the temperate climates for feeding and finishing, thus adding to the world's meat supply to the extent of billions of pounds.

THE ECONOMIC VALUE OF THE CHANGE

The discoveries that have brought about this era of control of tropical discases have a deeper significance than would appear upon the surface. Not only do they bring health and at least a greater degree of happiness to the hundreds of millions of human beings who live in the tropics, but also to the overcrowded temperate zones a prospective relief from the great food shortages that have been impending.

We find the price of meat growing higher every year as the grazing areas of the beef-producing countries have been encroached upon for farming purposes. Each generation finds the corn and the wheat areas of the world growing smaller in proportion to its population, and it has become evident that if humanity is to continue to be well fed it must look to the tropics.

Here, indeed, lies the hope of the world's future food supply. Untold mil-

lions of tons of provender might be raised where now dense jungles of unprofitable vegetation grow. What the United Fruit Company has done with the banana may be repeated with innumerable crops. Banana flour might take the place of wheat flour, and so on down through the category.

Meanwhile, with the restrictions imposed by disease removed, tides of immigration might set into the tropics, populating them with people who would cease to be a drain upon the food supplies of the temperate zones and become, on the contrary, contributors thereto. Tropical deserts may be irrigated, tropical swamps drained, tropical jungles tamed, and millions of acres of the richest land on earth added to the productive areas which feed and clothe the world. These times are coming not rapidly, but with a stride certain and inevitable as the world's population is increasing.

And what benefits they must bring to the race! New blood in the tropics is needed. The suns of centuries have burned out much of the initiative, the easy methods of gaining a livelihood have taken out much of the thrift, and the lazy ways of the tropics have eliminated much of the natural love of cleanliness of the people. New blood coming in may change these things to a very appreciable degree, and an even newer and better era of public health may ensue.

A CALL TO DUTY

When one contemplates what the heroes of medical science have made possible, and reflects that they have put into the hands of humanity powerful weapons of knowledge with which to combat our most deadly diseases, he cannot avoid feeling that their efforts will have been partially in vain unless all humanity is induced to aid in the work of capitalizing them

The world's death rate is probably about thirty per thousand. He who clips just one from that thirty saves more than a million and a half of lives a year. In a single quarter of a century the United States clipped five from its death rate, and if the world could only do as well in the next quarter of a century as the

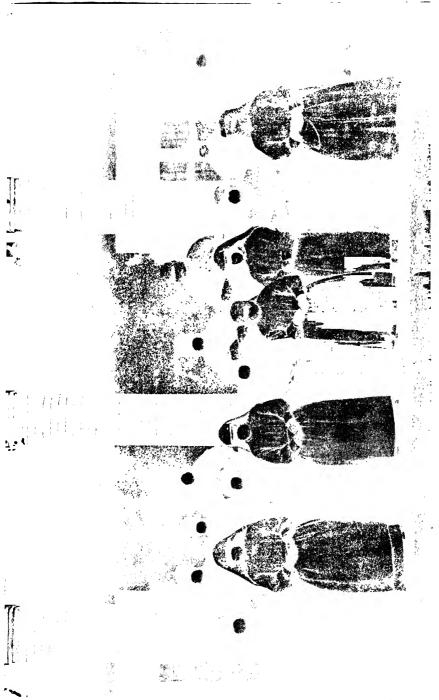


Photo from Catholic Foreign Missionary Society of America

MISSIONARIES FIGHTING THE PLAGUE

"When we see Naples, in the seventeenth century, as helpless as a new-born babe in the grip of a plague during which 380,000 souls perished in six months; when we see Constantinople, in 1812, with 144,000 deaths; when we see London, in the days of the great plague, with 70,000 of its population carried off; when we go back to China and behold a few short years in the fourteenth century with a 'black death' mortality record of 13 million souls; . . . not till then can we begin to appreciate what it all means" (see page 344).

and the results are so visible that the work is spreading everywhere. The fight of the commission and its forces is to establish sanitary privies in the country, and to teach the children and their parents that either the prevention of soil pollution or the wearing of shoes will prevent the disease, and that both together insures one against it.

The remaining problem is one of getting the people who have the disease to take the salts-thymol course of medicine. In Porto Rico, Dr. Bailey K. Ashford and his associates have cured well nigh half a million cases, and the work is still going on to the extent of some twenty thou-

sand cases a year.

The entire work of Dr. Ashford in Porto Rico has been a wonderful success. He went there with a death rate as high as that at Panama. The people were hopelessly ignorant, wholly indifferent to sanitation, and without a single idea of the cause of ordinary diseases that are contracted by infection. with all that, the principles of sanitary science that were laid down in Cuba triumphed in Porto Rico as brilliantly as they have triumphed anywhere else in the Notwithstanding the fact that they were handicapped for funds and had hookworm disease added to their list of troubles, Dr. Ashford and his aides were able to bring about a death rate that is lower than that of Panama itself today.

WONDERFUL RESULTS IN THE PHILIPPINES

What happened in Porto Rico finds something of a counterpart in the Philippines. When the Americans took possession of Manila the death rate averaged 46.11 a thousand during a period of four years. By strenuous work and a faithful adherence to the principles of sanitation there were laid down in Cuba, the death rate has been forced down until it is now about 35 per thousand.

A death rate reduced in the same proportion in the United States, with our present population, would mean a saving of 1,100,000 lives annually in this country. They were able over there to make a showing of a death rate of only 4.84 per thousand among the employees of the Philippine government. They had cholera knocking at their doors all the time

and several times running past their defenses. But they have kept hammering away year in and year out, and have set a record in public sanitation there that is a fit companion-piece to the work at Panama and Porto Rico.

They have cut down the number of new cases of leprosy each year from 700 to 200, and have reduced the number of lepers in the island from 5,000 to 2,000. They had a hand in proving that beriberi is a disease caused by a prolonged diet of polished rice. The phosphorous in the pericarp of the rice is needed by the system and its absence is responsible for the disease. Chickens fed constantly on polished rice contract the disease, while those fed upon unhulled rice never do. perhaps the most striking achievement in the Philippines has been the practical abolition of smallpox. When we went into the Philippines there were 40,000 deaths a year from the disease, where today there are only about 300 a year. Vaccination triumphed.

THE NEW ERA

Throughout the latitudes where insectborne diseases reign a new sentiment has arisen which promises, under the stress of persistent campaigns of education, to sink deep into the public mind. Its motto is the banishment of these diseases.

The fundamental principles of the fight are expressively laid down in simple terms like these: "No mosquitoes, no malaria, no yellow fever, no dengue. No fleas, no bubonic plague; no lice, no typhus; no tsetse fly, no sleeping sickness; no ticks, no spotted fever." Wherever governments have power to get back of these campaigns and compel the people willy-nilly to adopt the proper measures, remarkable results can be obtained.

Not only does sanitary science open up the tropics for the benefit of man himself, but for his domestic animals as well. When the United States took over the Philippines there had been introduced a terrible epidemic among cattle, carabao, and horses. The disease promptly was diagnosed as the terrible rinderpest. It killed untold thousands of head of horses, cattle, and carabao, in some places nine out of every ten dying from the disease.



Photo from Bureau of Insular Affairs

PREVENTING PLAGUE IN MANILA

In order to guard against infection spread by rats, the sanitary authorities of Manila organized a special corps whose duty was to seal with cement all openings which could serve as rat refuges. Compare photo on page 352.

majority must have been directly or indirectly victims of malaria.

But where steps as stern against malaria are taken as are required for the eradication of yellow fever, the results are magnificent. In Italy an anti-malarial campaign cut down the number of deaths from 16,000 a year to 4,000. In Greece, on the plains of Marathon, in 1906, 90 per cent of the sickness was due to malaria; in 1908 only 2 per cent of the sickness was due to it.

The wonderful results attained in fighting malaria at Ismailia, on the Suez Canal, surpasses anything that has been done in any part of the world. In 1900 there were 2,284 cases of malaria in that town. Sir Ronald Ross was called there to consider methods of banishing the disease, and laid out a program in that direction. In 1901 the number of cases fell to 1,990; in 1902 to 1,551; in 1904 to 90; in 1905 to 37. Since that time there have been no cases reported except such as were infected before visiting Ismailia. The malarial mosquito was absolutely exterminated there—something which probably has not been done in any other part of the earth.

One might go on indefinitely citing cases where cities and districts have arisen in their might to put an end to malaria and with magic results.

HOOKWORM DISEASE VANQUISHED

If vast consequences have grown out of the solution of the mysteries of yellow fever and malaria, they are probably no greater than are destined to come to the people of tropic and semi-tropic regions through the mastery of the hookworm.

Around the earth there stretches a belt 66 degrees wide, embracing 47 countries and an area of 15 million square miles, in which there lives a population of nearly a billion people. This belt is the hookworm belt of the world. How many cases of this distressing and strength-wrecking disease there are in this vast territory cannot be estimated with any degree of approximation.

In 1904 some 90 out of every 100 of the working population of Porto Rico had the disease. In Colombia 90 per cent of the people living between sea-level and the 3,000-foot level were suffering from it. Fifty per cent of the people in British Guiana are said to be afflicted. Not less than 1,800,000 of the people of India are reported as having the disease, and in the southern part of China it is estimated that three out of four people are sufferers.

The economic loss involved is beyond estimate. In Porto Rico the physically sound coffee-picker picks from 500 to 600 measures of coffee a day; scores of those suffering from hookworm disease can pick only from 100 to 250 measures a day. In some regions it is estimated that not more than 33 per cent of the natural efficiency of any force of men can be exercised because of the terrible problem of hookworm disease.

Yet hookworm disease is about the most easily mastered of all the diseases in the category. Its cause is easily demonstrable to the laymen, even to the ignorant layman, because he can see, without the aid of a microscope, the little hair-line worms that cause it. Its spread is easily checked, because the wearing of shoes and a little care against soil pollution is all that is demanded.

A SIMPLE AND EASY CURE

It is easily cured, because in most cases simply a dose of epsom salts, followed by a dose of thymol, and that in turn by another dose of salts, is effective. Thymol is made from the thyme of the garden, and is just about as simple and as harmless in its action as the epsom salts. If the first treatment does not answer, the second one usually will. Furthermore, the disease is one that lends itself admirably to the getting of quick results. It converts a lazy, sickly, good-for-nothing boy or girl into a sprightly, energetic one in the course of a few weeks.

That has been the secret of a major portion of the success of the Rockefeller Sanitary Commission in its work of ridding the South from the disease. The results were so striking that the States and the counties were glad to help along the task. Tens of thousands of so-called "poor white trash" have been cured of it,

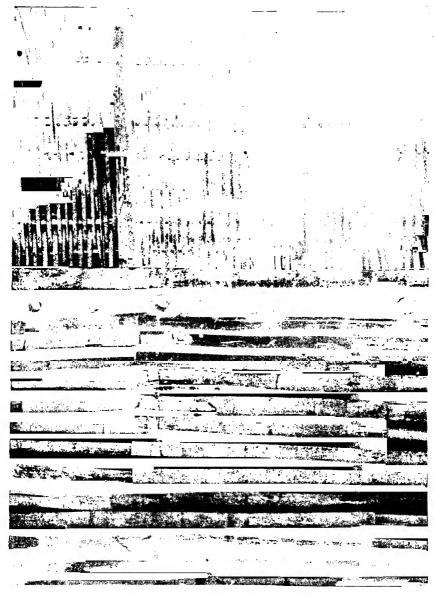


Photo from Bureau of Insular Affairs

A SOURCE OF PLAGUE INFECTION

These holes in the bamboo house-supports in Manila were found to afford shelter and nesting-places for rats, and so became dangerous to the public health of the city, for bubonic plague is transmitted by fleas carried on rats. How this danger was removed is shown in the picture on page 354.

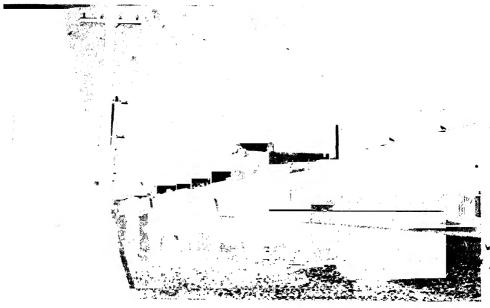


Photo from A. W. Cutler

PRIMITIVE SANITATION: BUZZARDS AT VERA CRUZ FOLLOWING A SCAVENGER'S CART

These birds are protected by law and may be seen strutting sedately about the streets in every direction. They are largely responsible for the present excellent sanitary condition of Vera Cruz, now looked upon by the Mexicans as a health resort.

most every country in the world. It plies its nefarious trade day in and day out, year in and year out, killing its millions of souls, some directly, but more through undermined constitutions which have permitted other diseases to be written upon the death registers.

We do not have to travel to the tropics to see humanity living in close contact with the malarial mosquito and apparently indifferent to the ravages of the disease. Dr. L. O. Howard, perhaps America's foremost authority in economic entomology, estimates that the financial loss inflicted at home upon the people of the United States by malaria amounts to a hundred million dollars a year.

Sir Ronald Ross gives an idea of the extent, economic consequences, and geographical influence of malaria when he says that it "is important not only because of the misery it inflicts upon mankind, but because of the serious opposition which it has given to the march of civilization in the tropics. Unlike many diseases, it is essentially endemic, a local malady, and one which unfortunately

haunts more especially the fertile, well-watered, and luxuriant tracts—precisely those of greatest value to man. There it strikes down net only the barbaric indigenous population, but, with still greater certainty, the pioneer, of civilization, the planter, the trader, the missionary, and the soldier.

"It is therefore the principal and gigantic ally of barbarism. No wild deserts, no savage races, no geographical difficulties, have proved so inimical to civilization as this disease. We may say that it has withheld an entire continent from humanity—the immense and fertile tracts of Africa; what we call the Dark Continent we should call the Malarious Continent; and for centuries the successive waves of civilization which have flooded and fertilized Europe and America have broken themselves in vain upon its deadly shores."

Africa affords no statistics of the widespread prevalence of malaria, but in India, which at its worst is better than Africa, nearly five million souls died of fevers in a single year recently, and the



Photo by Louise Birt Baynes

THE DAINTIEST GUEST

A picture of an inquisitive and very puzzled humming-bird probing an artificial flower lish sparrow, house-finch, tree and violet green swallow, purple martin, housewren, Parkman's wren, Bewick's wren, Vigor's wren, and Texas Bewick's wren, white-breasted nuthatch, tufted titmouse, black-capped chickadee, Oregon chickadee, Carolina chickadee, robin, and three varieties of bluebirds—eastern, western, and mountain. To this list the Carolina wren ought probably to be added; though while I do not know personally of any record of its actually building in a bird-box, it builds about houses and in the most unheard of and crazy places.

Robins and phoebes may be encouraged by shelves conveniently placed beneath the roofs of porches, piazzas, and sheds, while the insect-eating barn and eave swallows may often be helped in their choice of nesting sites by a supporting shelf. Vines on trellises or about the piazza posts are attractive nesting sites for chipping sparrows, as well as robins, and I once knew of a bluejay that built in a wistaria vine overhanging a friend's front porch.

One can never tell just what birds are going to do. Crows are reported to have nested in one of the squares in the city of Philadelphia and on Beacon Hill in Boston, while a pair of sparrow-hawks have bred beneath the eaves of the Lawrence Scientific School in Cambridge, Mass.

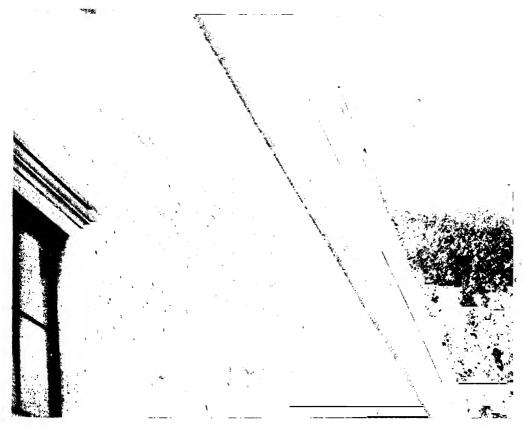
Chimney swifts should also be encouraged, and when possible the chimneys



MOTHER AND DAUGHTER

Photo by Ernest Harold Baynes

This is a photo of a wild chickadee feeding her young in June. She does not fear in summer the hand that feeds her in winter



A COLONY OF EAVE SWALLOWS

Photo by Fred B. McKechnie

This colony of swallows built their nests beneath the eaves of a barn at Luenburg. Vt. Note the partial support given by the narrow molding. These eave swallows become much attached to their homes, and if undisturbed will return year after year with unfailing regularity.

but are now manufactured by at least two people in this country. Those on my place have been occupied by screechowls, bluebirds, chickadees, tree-swallows, flickers, white-breasted nuthatches, and great-crested flycatchers. Housewrens, which are very local in our part of the country, have so far avoided them, and I have failed ignominiously to attract either the downy or the hairy woodpeckers, both of which frequent my woods.

One firm makes bird-houses out of natural hollow logs or limbs, a hole bored in the side, and with wooden cap and bottom, while another makes an imitation woodpecker's nest of pottery. The Berlepsch type are, however, in my opinion, far and away ahead of these others.

BIRDS THAT WILL NEST IN PREPARED HOUSES

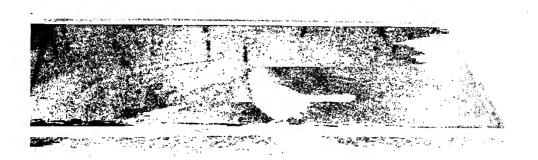
About houses and buildings, particularly those on our farms, the ordinary type of bird-house rather than the hollow log is perhaps more appropriate. Bluebirds, tree-swallows, and house-wrens take to them readily, and if you have a large house on a high pole you may be lucky enough to attract a colony of martins. Chickadees, great-crested flycatchers, and screech-owls may use these boxes, and the following is a list of birds recorded as having bred in nest boxes of one sort or another:

Wood-duck, sparrow-hawk, screechowl, flicker, red-headed woodpecker, great-crested flycatcher, starling, Eng-



A BALTIMORE ORIOLE AFTER A BATH Photo by Ernest Harold Baynes

The Baltimore oriole is remarkable for its bright colors, and to these it owes its name, as the livery of the Lords Baltimore, who founded Maryland, was orange and black of just those tones that the bird exhibits. Cats have been eliminated on this place.



A BROWN THRASHER BATHING

Photo by Louise Birt Baynes

"Water, particularly during the summer months or times of drought, is necessary for the birds. If they can't get it on your place, they will be forced to look elsewhere. The proper installment of a drinking fountain or bird bath is a simple affair, and one that is almost sure to prove a great attraction to the birds, as well as a never-failing source of entertainment to the owner" (see text, page 333).



SONG-SPARROWS TAKING A BATH Photo by Ernest Harold Baynes

"A pool with foundation of concrete sunken in the ground . . . can be made a very interesting feature of any garden, to say nothing of its attractiveness to birds. It is essential, however, that the slope of the sides should be gradual and the water at the edges shallow" (see page 333).

position at that. They seem absolutely fearless, come and go at will, though only a short distance away are gunners who are waiting to take a crack at them.

Only a few of us have ponds to which geese may be attracted, but the above experiment shows what can be and has been done in the way of attracting and taming locally the shy wild geese.

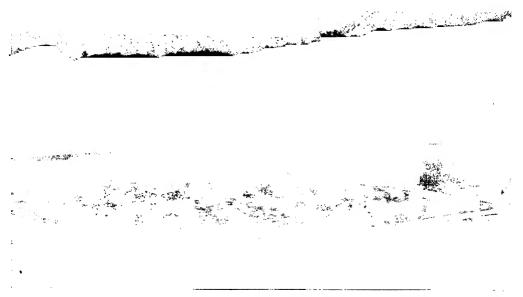
HOUSES FOR THE BIRDS

Of bird-houses, to be supplied for those birds that nest about buildings or in holes of trees, there seems to be an almost infinite variety; tree stumps, real or artificial, boxes, cottages, houses, large and elaborate mansions, barrel-houses, gourds, flower-pots, tin-cans, shelves, and all kinds of contraptions.

Mr. Ernest Thompson Seton went so far as to construct on his place in Connecticut a huge artificial stump, filled with imitation woodpeckers' holes, etc. He attracted numbers of different kinds of birds and animals, and he seems to have had no end of fun with it. It is not allowed to all of us, however, to be given either the opportunity or the enthusiasm possessed by Mr. Seton.

Of the various kinds of houses space will allow but brief mention. On my own place, which is covered largely with woods, I have used the Berlepsch type of vertical boxes with considerable success. These are simply sections of logs, hollowed out by special machinery in a very particular manner to represent woodpecker cavities, with entrance hole in side of desired diameter, and covered by a wooden cap or roof that may be lifted for purposes of investigation or in order that the nests may be cleaned out from time to time, the whole bolted to an oaken batten, by which they may be fastened to trees (see pages 323 and 325).

These may be obtained in Germany,



A FLOCK OF MALLARDS AS VISITORS

Photo by Dr. John C. Phillips

"If wild rice can be made to grow, ducks will be sure to come in greater numbers each year, while regular feeding with corn at proper times may prove an additional attraction to whole flocks of ducks during the migration. Tame call-ducks may be introduced, and if there are near-by woods, nest-boxes for the attraction of the wood-ducks should be put up" (see page 337).



WILD BLACK DUCK ON A GAME PRESERVE

Photo by Herbert K. Job

"Mr. Herbert K. Job, State Ornithologist of Connecticut, is having some very interesting experiences on a game preserve in Connecticut, where low-lying areas have been flooded and the wild ducks attracted in increasing numbers each year from miles around" (see page 337).



WHAT BIRDS CAN DO

Photo by Joseph H. Dodson

A great-crested flycatcher house, with bluebird, suspended from a pear tree, from which Mr. Dodson last year picked eight bushels of pears with not a worm hole in one, and that notwithstanding the fact that the tree had never been sprayed. A flycatcher is certainly a cheaper investment than a spraying-machine.

"About houses and buildings, particularly those on our farms, the ordinary type of bird-house rather than the hollow log is perhaps more appropriate. Bluebirds, tree-swallows, and house-wrens take to them readily, and if you have a large house on a high pole you may

be lucky enough to attract a colony of martins" (see text, page 341).

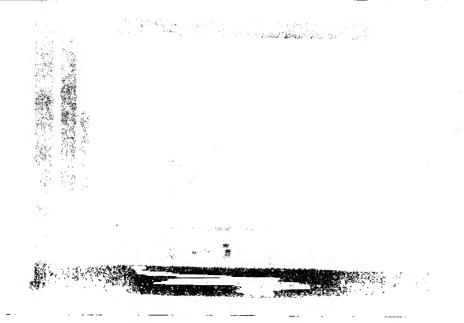
completely metamorphosed into a very attractive and interesting spot, replete with bird life.

If wild rice can be made to grow, ducks will be sure to come in greater numbers each year, while regular feeding with corn at proper times may prove an additional attraction to whole flocks of ducks during the migration. Tame call-ducks may be introduced, and if there are near-by woods nest boxes for the attraction of the wood-ducks should be put up.

One may even go into the raising of ducks, though this is often both bothersome and expensive, while the simple flooding of a meadow and intelligent planting of its shores is comparatively little trouble.

Mr. Herbert K. Job, State Ornithologist of Connecticut, is having some very interesting experiences on a game preserve in Connecticut, where low-lying areas have been flooded and the wild ducks attracted in increasing numbers each year from miles around (see picture, page 338).

I know of one man in Canada who several years ago fed a small flock of wild geese that chanced to alight in a pond close beside his house. The geese appreciated the treatment so much that they later returned with friends, and have kept it up from year to year until now I believe that he has had at one time several hundred wild geese virtually in his front yard, and in a very exposed



THE HOSTESS ENTERTAINS

Photo by Ernest Harold Baynes

"Window boxes are a never-ceasing source of enjoyment. Mr. Ernest Harold Baynes built the first I ever saw, at his home in Meriden, N. H., a particularly attractive one, which has helped him to become intimate with an astonishing variety of birds" (see page 332).



TAKING THE CAKE

Photo by Louise Birt Baynes

This photo shows how responsive birds are to a little attention and how tame they may become. This wild chickadee will enter the house, perch upon his favorite delicacy, and enjoy a meal in no way affrighted by the presence of his human entertainers.



A SANDWICH FOR TWO

Photo by Louise Birt Baynes

Having accepted the invitation, the bird settles down to enjoy his meal. The fact that he must share a sandwich with his host does not disturb him, for, like all birds, he is quick to recognize and trust a human friend (see picture, page 334).

or woodland glade may be flooded and a pond thereby installed, there is hardly any limit to the enjoyment that may be derived from a pond of this sort.

ATTRACTING THE WILD DUCK

There is a little woodland glade, containing an acre or so, on my place, an opening in the woods surrounded by red maples, birches, alders, poison sumach, white azalea, high-bush blueberries, etc., which I flooded one winter merely as a

safe skating pond for the children in the neighborhood.

Imagine my surprise and delight when one spring day, after the ice had gone out, I discovered there a whole flock of wild wood-ducks, and later during the summer was able to watch a flock of little "flappers," the progeny of a pair of wild black ducks that had bred there. Herons came there, too, and red wings frequented the edge of the pond. From an uninteresting swamp the place had been



Photo by Ernest Harold Baynes

THE BEST KIND OF A BIRD ON A HAT

left open at the top, and so constructed as to admit of their ready occupancy.*

THE ENEMIES OF THE BIRDS

Of bird enemies, cats are undoubtedly the worst, and maudlin sentiment should not be wasted upon them, for they are incorrigible. The plain, ordinary alley cat should be eliminated when possible, and they make fine fertilizers when planted about the roots of one's favorite grape-vine. Cat-possessing neighbors

*One of the most absorbing and interesting books of the present day, replete with information on the above subject, called "Useful Birds and Their Protection," by Edward Howe Forbush, State Ornithologist of Massachusetts, has been published by the Massachusetts Board of Agriculture and may be obtained from them for the sum of \$1.00.

should be warned that if their cats are caught trespassing they will be turned into fertilizer.

Red squirrels are next on the list and should be shot on sight, but I have never found the depredations of the gray squirrel to warrant similar treatment. Birdchasing dogs are a nuisance and should be restrained during the breeding season.

Skunks and foxes should both be discouraged, and the wily raccoon and elusive weasel also, if perchance they are found to lurk about.

Of the hawks, the cooper and sharpshinned hawks should both be shot at sight, while of the owls, the great horned is incapable of reform. The little screechowl is almost always beneficial on account of the numbers of mice it often destroys, but individual screech-owls are often destructive to bird life.

Crows and jays will bear watching. There seem to be good crows and jays, and then again individuals among them of exceeding bad habits, as many a long-suffering bird family knows to its sorrow.

In many places the English sparrows are pests and should be shot and trapped relentlessly. They are pretty canny birds, and if once they learn you are after them with a gun they quickly desert the premises. If owing to surrounding conditions gunning for them seems undesirable, traps may be used with telling effect. There are several kinds in use in this country.

Last, but not least, the black snake should be killed whenever found; its large size, great activity, tree-climbing propensities, and taste for eggs and small birds have fairly won for it the reputation of being one of the birds' deadliest enemies.

REDEEMING THE TROPICS

By William Joseph Showalter

Author of "Battling with the Panama Slides," "The Countries of the Caribbean," "The Panama Canal," in the National Geographic Magazine

In THESE days when medical science has been recording one triumph after another over germ-produced diseases, when the germ-hunter in his laboratory has been ascertaining the causes of so many mysterious afflictions and laying the foundations for one preventive measure after another, people all but lose sight of the tremendous debt humanity owes to the expert in experimental medicine and the sanitarian. Indeed, he would be a prescient mathematician who could calculate what the vast amount of this debt is.

It is only when we look back over the records of the past, when civilization was young and humanity without knowledge of the causes of the great epidemic diseases, that we can have a faint appreciation of what the patient man of the microscope has wrought in humanity's behalf.

When we see Naples, in the seven teenth century, as helpless as a new-born babe in the grip of a plague during which 380,000 souls perished in six months; when we see Constantinople, in 1812, with 144,000 deaths; when we see London, in the days of the great plague, with 70,000 of its population carried off; when we go back to China and behold a few short years in the fourteenth century with a "black death" mortality record of 13 million souls, and to Europe, in the great

scourge of 1347-1350, and see 25 million people dying; when we come on down the years and see the untold millions who have died from the numerous pestilences which have inflicted death upon mankind; then, and not till then, can we begin to appreciate what it all means.

Even then our appraisal will fall far short of the truth, for in those times the world was, in a sense, larger, the seas were broader, and the distances on land much greater than in these days of highly developed transportation and commerce. How can the mind conceive of the terrible toll epidemic diseases would take today, with our world-wide commerce, with our metropolitan and cosmopolitan cities, and with the constant commingling of the peoples of all lands, were it not for preventive measures?

MAP-CHANGING MEDICINE

Throughout the history of the ages one may read of great changes in the maps of the earth that have resulted on the one hand from the ravages of disease and on the other from the discovery of methods of combatting it.

We see the "glory that was Greece" depart because of the terrible toll exacted by malaria; we see a Panama Canal made possible because of the knowledge of the causation of yellow fever that came to



In the midst of a tramp across the winter snow the naturalist halts for a rest and a little lunch, to which he invites a passing bird friend. Cordial relations have already been established, but the repast has not yet been begun (see picture, page 335)

3 oz.; oats, 1½ oz.; dried elderberries, 1½ oz.; sunflower seeds, 1½ oz.; ants' eggs, 1½ oz."

A SIMPLE AND AT-TRACTIVE FOOD SUPPLY

Perhaps the simplest scheme of feeding, the least trouble and the most attractive to numbers of birds, is the tying of a piece of suet to a convenient limb, or perhaps to the balustrade of one's piazza, preferably in a protected spot and one that can at the same time be easily watched from some window (see page 332).

In all these food-houses various kinds of food should be supplied — suet, crumbs, millet, he mp, rapeseed, canary-seed, and the like. On my place the birds have such a wealth of natural food that it is only during

the winter storms and when the ground is covered with snow that they visit the food-houses; but on many other places—as, for instance, in Meriden, N. II., where Mr. Baynes and the Meriden Bird Club are doing such good work—there have been food-houses erected on places along the main street, entirely apart from any protecting shrubbery or natural food supply, and many of these food-houses seem to be well patronized both winter and summer.

Water, particularly during the summer months or times of drought, is, of course, necessary for the birds. If they can't get it on your place, they will be forced to look elsewhere. The proper installment of a drinking fountain or bird bath is a simple affair, and one that is almost sure to prove a great attraction to the birds, as well as a never-failing source of entertainment to the owner.

Drinking fountains may be purchased ready made or manufactured at home.



Photo by B. S. Bowdish

ON INTIMATE TERMS

This jolly little white-breasted nuthatch has just taken a dainty morsel from the lips of its friend. These little birds are very clever climbers and can run up and down tree trunks in the most agile manner.

Almost any shallow receptacle will do when placed in some quiet spot not too far from protecting shrubbery, but out of reach of skulking cats. Where the cats have not all been eliminated, it is sometimes safer to place the bath on a pedestal.

A pool with foundation of concrete sunken in the ground, partially filled with earth and stones and planted with cattails, Japanese iris, or other moisture-loving plants, or perhaps with water-lilies and inhabited by a few goldfish, can be made a very interesting feature of any garden, to say nothing of its attractiveness to birds. It is essential, however, that the slope of the sides should be gradual and the water at the edges shallow (see pages 338 and 339).

If one has a brook or natural pond on the place, much can be done, particularly if the bottom of the pond is suitable for the planting of food for ducks. If the lay of the ground is such that a meadow



Photo by Ernest Harold Baynes

A BLUEJAY FEEDING ON SUET

"Perhaps the simplest scheme of feeding, the least trouble, and the most attractive to numbers of birds, is the tying of a piece of suet to a convenient limb, or perhaps to the balustrade of one's piazza, preferably in a protected spot and one that can at the same time be easily watched from some window" (see page 333).

trays from the weather and at the same time admit light and allow of easy observation. These, when placed among the shrubbery about one's house, prove most attractive.

Baron von Berlepsch has invented also a food bell that supplies grain, etc., automatically from a receptacle above, and which may be suspended from a tree or piazza roof, or any other convenient place (see page 331).

Window boxes are a never-ceasing source of enjoyment. Mr. Ernest Harold Baynes built the first I ever saw at his home in Meriden, N. H., a particularly attractive one, which has helped him to become intimate with an astonishing variety of birds (see page 336).

Food shelves may be put up in all sorts of protected places—about houses, against tree trunks, etc.; and a food car, a sort of moving free-lunch counter, which may be run conveniently on a wire from window to neighboring tree, is actually

manufactured by one enterprising gentleman; and the same man builds also a sheltered food-house that turns with the wind like a weather vane, so as to present always a lee side for the better protection of the birds (see page 326).

Baron von Berlepsch originated also what he calls a food tree, a freshly cut evergreen, preferably spruce or fir, or perhaps a discarded Christmas tree, set up in some convenient place, over which has been poured hot, and then allowed to cool, a mixture of food that is attractive to both insectivorous and graminivorous birds, the receipt for which is given in the little book, "How to Attract and Protect Wild Birds":*

"White bread (dried and ground), 4½ oz.; meat (dried and ground), 3 oz.; hemp, 6 oz.; crushed hemp, 3 oz.; maw, 3 oz.; poppy flour, 1½ oz.; millet(white)

*For sale by the National Association of Audubon Societies, 1974 Broadway, New York City, N. Y. Price, 40 cents.

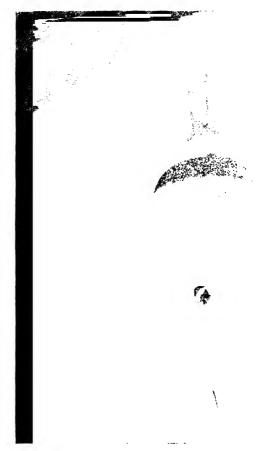


Photo by Ernest Harold Baynes

THE FOOD BELL

"Baron von Berlepsch has invented a food bell that supplies grain, etc., automatically from a receptacle above, and which may be suspended from a tree or piazza roof or any other place that seems best" (see page 332).

Sunflowers may be planted in groups about the flower garden or in lines among the rows of vegetables; wild sarsaparilla and pokeberry along the boundary walls; while if you have a corner somewhere in the fields that can be planted with buckwheat and Japanese millet, it will prove a great attraction, particularly in winter.

FOOD-HOUSES AND SHELTERS

In bad weather, however, particularly in the North, where we are so apt to be covered up with snow, more artificial means of feeding should be resorted to, and food stations, food-houses, and food shelters of various sorts should be established in proper places. If quail or grouse

are to be fed, inconspicuous bough shelters may be built in protected places among the fields or woods most frequented by them, while about the house or among the neighboring plantations all sorts of devices may be resorted to.

Baron von Berlepsch, in Germany, has invented a food-house, an adaptation of which, called the Audubon food-house, has been much used on this side of the water, and is most satisfactory (see page 327). It consists of a square hip roof, with vertical glass sides suspended beneath and open at the bottom, the whole supported on a central rustic cedar post, encircled with food trays beneath the roof. The glass sides protect the food

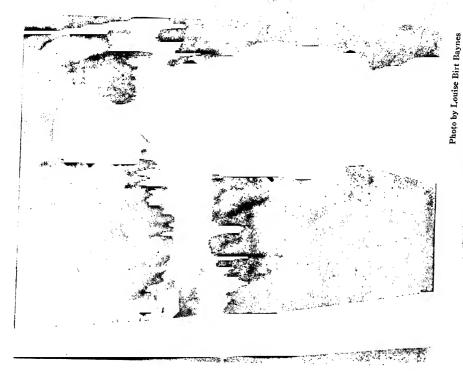


Photo by Ernest Harold Baynes

A SHY HAIRY WOODPECKER AT DINNER

The hairy woodpecker is a somewhat shy bird, who prefers the forest to the orchard and is not often seen about the house. His note is louder and sharper than that of most woodpeckers and cannot by any stretch of the imagination be called musical.

A FRIENDLY CHICKADEE The chickadee is found in all parts of the East, from Labrador to Maryland, and in all seasons of the year, but is seen most often in winter. They are unusually companionable birds and their tameness, quaint notes, and friendly ways make them general favorites.

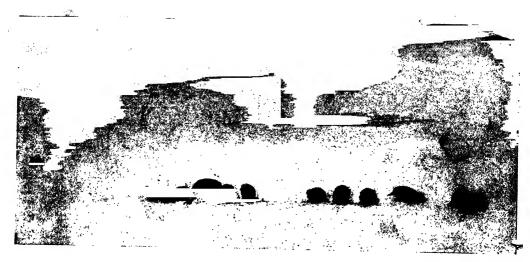


Photo by Ernest Harold Baynes

FLOCK OF QUAIL AT A FOOD STATION

"In bad weather, however, particularly in the North, where we are so apt to be covered up with snow, more artificial means of feeding should be resorted to, and food stations, food-houses, and food shelters of various sorts should be established in proper places. If quail or grouse are to be fed, inconspicuous bough shelters may be built in protected places among the fields or woods most frequented by them" (see page 331).



Photo by Ernest Harold Baynes

PINE SISKINS AND RED POLLS FEEDING ABOUT A HOUSE: NEW HAMPSHIRE

The pine siskin is a lover of evergreens and spends the winter wandering from copse to copse in search of seeds and pine cones. The red poll is a winter visitor from the far North, and with its rich crimson head and breast makes a pretty picture in the snow.



PAYING A MIDWINTER VISIT

Photo by Wilbur F. Smith

This shows a bird visitor attracted by the lump of suet fastened to the old pear tree. A lump of suet set in some convenient place is perhaps the surest way of securing bird visitors in midwinter, for it is a food supply they greatly appreciate.

protected resort of such birds as stayed with us.

In the Year Book of the Department of Agriculture for 1000 there is a most interesting article on "Plants Useful to Attract Birds and Protect Fruit," by W. L. McAtee. In this there is a list, on page 186, of the best trees and shrubs for attracting birds, given in the order of their attractiveness, as follows: Elders, raspberries and blackberries, mulberries, dogwood fruits, sumachs, wild cherries, blueberries, wild grapes, pokeberries, Virginia creeper berries, bayberries, juniper berries, service berries, holly berries, strawberries, the fruits of viburnums, hackberries, huckleberries, haws, spicebush berries, rose hips, sarsaparilla, sour gum, gooseberries, currants, and snowberry.

To the above list is added the following supplementary list of some other plants known to be attractive to birds,

and to this the names of other species doubtless might be added: Manzanita, barberry, buffalo berry, silverberry, buckthorn, mountain ash, China berry, California Christmas berry, pepper tree, magnolia, nockaway, lote bush, and bluewood.

With the above very comprehensive lists to choose from, it is not a difficult matter to make out a list of trees and shrubs for almost any place, no matter how small, that will supply its quota of birds' food from early summer to the following spring, while if the place is a large one, or the problem at all difficult, it may be the best policy, as well as in the end the most economical, to consult some competent landscape architect as to the proper disposition of the proposed plantations. What is worth doing at all is always worth doing well.

Besides the trees and shrubs in the above lists, there are many herbaceous plants whose seeds are attractive to birds.



Photo by Thomas E. Marr and Son

A JUNCO VISITING AN AUDUBON FOOD-HOUSE

"The Audubon food-house has been much used on this side of the water and is most satisfactory. It consists of a square hip roof, with vertical glass sides suspended beneath and open at the bottom, the whole supported on a central rustic cedar post, encircled with food trays beneath the roof. The glass sides protect the food trays from the weather and at the same time admit light and allow of easy observation. These, when placed among the shrubbery about one's house, prove most attractive" (see pages 331 and 332).

as well as to the birds, while lanes may be bordered with trees and shrubbery and walls covered with vines without any possible encroachment on the fields. An old pasture planted with savin and white pine, hawthorns, elders, barberries, cornels, viburnums, and the like, may easily be metamorphosed into a bird reservation and still be useful as a pasture.

For deciduous growth to be used for cover, choose those berry-bearing trees and shrubs whose berries are most popular with the birds; and, when possible, convenient sites for nest-building.

SOME USEFUL FOOD PLANTS

Care must also be taken in the choice of species, so as to get, if possible, a con-

tinuous supply of food, using such plants as the cherry, mulberry, raspberry, blueberry, huckleberry, etc., for the summer supply; elder and the various kinds of dogwood and viburnum, etc., for autumn; while for winter choose those plants which hold their fruit longest, such as the hawthorn, buckthorn, mountain ash, barberry, bayberry, sumach, wild rose, and the like.

Hedges, particularly if they are evergreen, are favorite resorts for birds, both in winter and summer, and an arbor-vitæ choose also those that may offer most , hedge is the best of them all. I remember such a hedge about one side of my father's old-fashioned garden that in summer invariably held its quota of robins', song sparrows', and chipping sparrows' nests, while in winter it was the

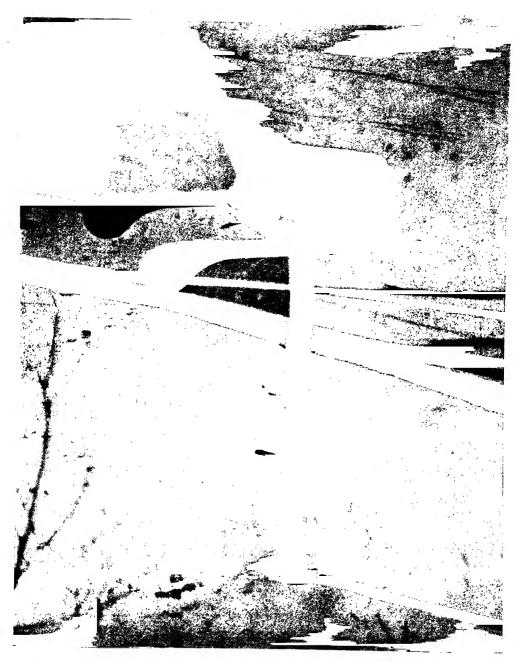


Photo by Ernest Harold Baynes

BLUEJAYS FEEDING IN WEATHERCOCK FOOD-HOUSE

"The same man builds also a sheltered food-house that turns with the wind like a weather vane, so as to present always a lee side for the better protection of the bird." (see page 332).

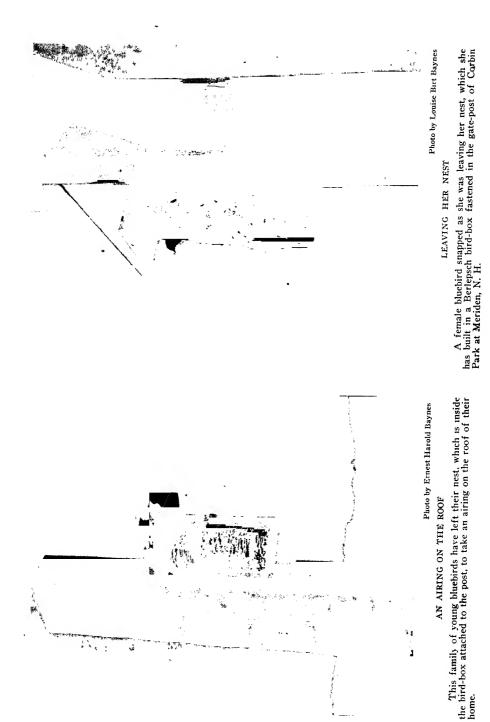


Photo by Joseph H. Dodson

A NEST SHELTER

A nest shelter on a tree, with a catbird going into its nest. Robins and brown thrashers also nest in them. "Of bird enemies, cats are undoubtedly the worst, and maudlin sentiment should not be wasted upon them, for they are incorrigible" (see text, page 342).

Photo by E. H. Forbush

BARN-SWALLOW ON ITS NEST

The barn-swallow is the most common of our swallows, and he arrives from the tropics in the middle of April and stays till late in September. He is a clever architect and builds his nest of mud and lines it with feathers. He generally chooses a beam or supporting shelf for his nest in the barn, and the little fellow in the picture considers that he has found an ideal location for his house.



Photo by Ernest Harold Baynes

FLICKERS USING A BERLEPSCH BIRD-BOX

"I have used the Berlepsch type of vertical boxes with considerable success. These are simply sections of logs, hollowed out by special machinery in a very particular manner to represent woodpeckers' cavities, with entrance hole in side of desired diameter, and covered by a wooden cap or roof that may be lifted for purposes of investigation or in order that the nests may be cleaned out from time to time, the whole bolted to an oaken batten, by which they may be fastened to trees" (see page 339).

surroundings of our farm buildings are in many cases much too bare and bleak.

The average house when surrounded by proper planting almost invariably looks better than if left to stand out cold and hard and with base-line unbroken. Wind breaks may almost always be planted somewhere, both with benefit to the farm



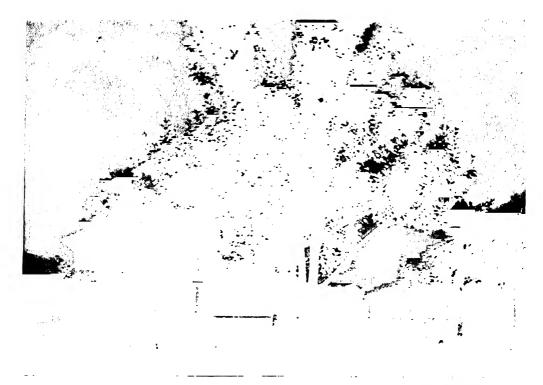
A SCREECH-OWL'S FAVORITE NEST-BOX

Photo by George R. King

"Of bird-houses, to be supplied for those birds that nest about buildings or in holes of trees, there seems to be an almost infinite variety; tree stumps, real or artificial, boxes, cottages, houses, large and elaborate mansions, barrel-houses, gourds, flower-pots, tin-cans, shelves, and all kinds of contraptions" (see page 339). The nest-boxes "on my place have been occupied by screech-owls, bluebirds, chickadees, tree-swallows, flickers, white-breasted nuthatches, and great-crested flycatchers" (see page 341).

winter be surrounded by the verdure of summer, we need not content ourselves with the bare poles of deciduous growth. Evergreens protect us and delight our eyes with their color and varying lights and shadows, and what is more beautiful than a pine wood or group of evergreens after a snow-storm?

Those of us who possess farms, while naturally jealous of every encroachment on our fields, can always find some place which may be planted. The immediate



A BIRD-LOVER'S GARDEN

Photo by Joseph H. Dodson

The garden of Mr. Dodson, at Evanston, Ill., showing the various devices used by him in attracting birds: bath, weathercock food-house, houses for great-crested flycatchers, bluebirds, tree-swallows, and martins, from left to right in the order named.

breed nearly every year, while in the second area only from three to five different species build their nests.

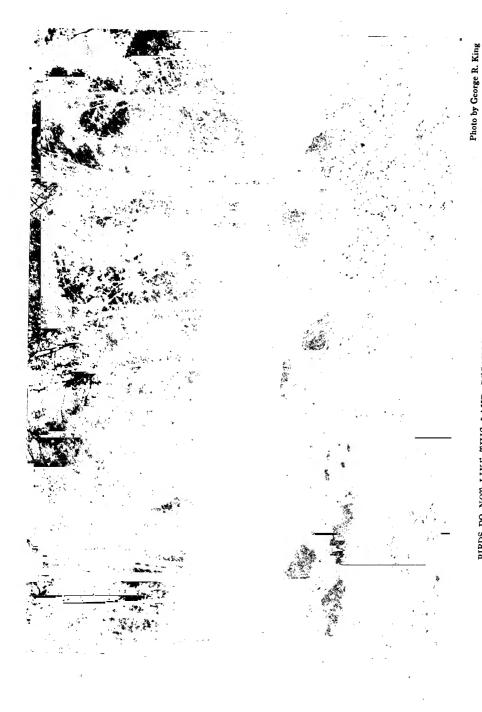
Almost every one who lives in the country can do something in the way of attractive planting about his house and grounds, and even in the more closely settled suburbs almost every place, no matter how small, can by judicious planting be made attractive to birds. Even a back yard may in its limited way, with proper treatment, be made a regular rendezvous for birds in the vicinity.

THE IMPORTANCE OF EVERGREENS

On suburban places and in the country the use of evergreens, large plantations when possible, is of prime importance as a protection from the elements, as a source of natural food supply, and on account also of the nesting sites they invariably offer. Nothing is finer than a plantation of white pine or hemlock. Spruce and balsam are beautiful and offer tempting nesting sites, while the native red cedar seems a favorite tree for the nest-builders and also contributes its berries toward the winter supply of food.

There is a huge hill at the edge of the sand dunes at Ipswich, Mass., swept by all the storms that come in from over the ocean, that years ago was as bare as a billiard ball, but upon one side of which the enterprising owner set out a large plantation of evergreens. Today that hillside is a Mecca for the birds from miles around, and noted among the bird lovers of the region for its varying bird life both winter and summer.

From an artistic standpoint, also, the use of evergreens is to be recommended. In these days, when there seems to be such an exodus from city to country, why shouldn't our country homes be made to look as attractive in winter as in summer? While we of the North may not in



BIRDS DO NOT LIKE THIS LAND, BECAUSE OF THE ABSENCE OF UNDERGROWTH

"The most important factor in attracting birds is the supplying of cover suitable for their wants. With this properly done, except in the (see text, page 315).



Photo by Thomas E. Mars and Son.

ANOTHER PLACE WHERE BIRDS LIKE TO NEST

A wood road at The Pines. In the thickets along its sides the cathird, cuckoo, goldenwinged warbler, chestnut-sided warbler, bluejay, brown thrush, chewink, purple finch, tanager, and other birds find attractive nesting sites. This wood road runs through that portion of Mr. Kennard's place on which the undergrowth has been encouraged, and on which over thirty varieties of birds breed each year (see page 315). Contrast with the scene on page 320.



A BIRD PARADISE

Photo by Thomas E. Marr and Son

A woodland path within a few feet of the residence at The Pines, flanked by undergrowth, ferns, blueberries, huckleberries, dogwoods, etc. Along this path a ruffed grouse builds its nest, as do also chewinks, black and white creepers, and oven birds, while in the trees pine and black-throated green warblers, bluejays, and robins also build their nests.



WHERE BIRDS GET FOOD AND PROTECTION

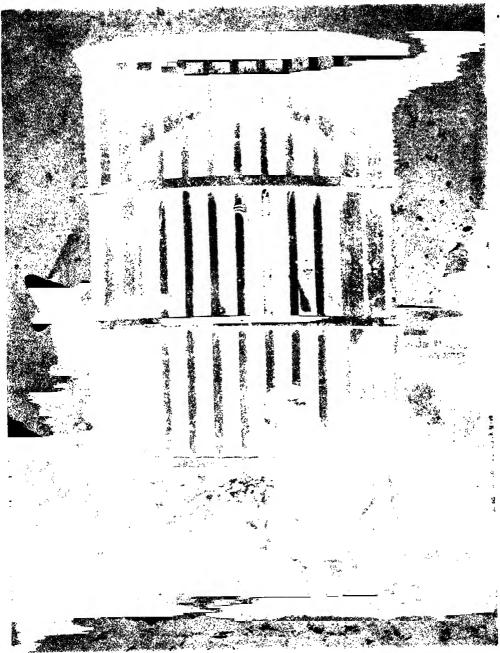
Photo by Thomas E. Marr and Son

A turn of the driveway at The Pines, showing plantation of rhododendrons, flowering dogwoods, and black alders, with an undergrowth of ferns and fox-gloves. Much frequented in summer by catbirds and chewinks, while in winter it affords both food and protection for many winter birds—provided there are no cats about the place.



A LAMP-SHADE HEAD-DRESS

Photo from A. W. Cutler
A front and rear view of the famous head-dress worn only by the Tehuana Indians of
Mexico



PRIMITIVE BUT HAPPY

Photo from A. W. Cutler

How the little Mexican Indian children play around the wooden-barred windows down at Tehuantepec. Tehuantepec is in the State of Oaxaca, about 60 miles from the border of Guatemala.



MEASURING THE GRAIN

This is one of the scenes of the threshing floor, as primitive to-day as it was in the Biblical period 2000 years ago. It helps us to understand the phrase, "good measure, pressed down and shaken together and running over." Luke vi: 38. Photo by American Colony, Jerusalem.

Miles Carl



MAKING BUTTER

Butter-making in the Holy Land is a very primitive affair. A goat's skin is half filled with milk, then inflated with air and sealed. It is hung with ropes on a tripod roughly made of sticks and is rocked to and fro by the women until the butter is formed. Photo by American Colony, Jerusalem.



A TYPICAL VILLAGER'S COSTUME

THERE is a long shirt made of white cotton cloth. Over this is a sort of gabardine made of striped goods; red and yellow or black and yellow are the favorite colors. A dome-like red fez is wound about with a turban. In the districts north of Jerusalem the turban consists of a large square of white linen with a colored border woven in. Photo by the American Colony, Jerusalem.

April Dang and Artists of the Agent

THE VILLAGE MOTHER: PALESTINE "A cap, perhaps decorated with a blue bead or some charm to keep off spirits and the evil eye, completes its apparel." The child shown here has outgrown the swaddling clothes.

ENCOURAGING BIRDS AROUND THE HOME

By Frederick H. Kennard

awakened to the importance of bird life to the citizens, and at last enacted some very wise legislation, forbidding the killing of migratory and insectivorous birds, putting migratory game birds under Federal control, and forbidding the importation of plumage from abroad, public interest in birds and their great economic value seems to have been stirred as never before.*

Spring will soon be here, and those of us who are thinking of doing our little toward attracting the birds must be getting ready for the early arrivals from the South.

Birds come north for the very special purpose of finding a proper place for the rearing of their young, and, this task accomplished, as autumn approaches, soon depart in search of areas where there will be throughout the winter plenty of food and cover and a more congenial climate.

If we want to make our homes attractive to birds, we must always keep the above facts in mind. If in summer we want to attract the migrants from the South, as well as the permanent residents, we must furnish them with proper places for the rearing of their young, which should include not only nesting sites, but cover, food, and water; and if in winter we want to keep some of the permanent residents about our homes and attract migrants from the North, we must remember that they are again in search of food and cover.

Once having attracted the birds, a sharp lookout must be kept in order to protect them from their enemies—cats, bird-hunting dogs, red squirrels, skunks, foxes, and other predatory animals, not

* Numerous reports on the economical value of birds have been issued by the United States Department of Agriculture. One of the best books on the subject is entitled "Birds in Their Relation to Man," by Weed and Dearborn, published by J. B. Lippincott & Co., Philadelphia, Pa.

forgetting the small boy that used to be ubiquitous; English sparrows, horned owls, and sometimes crows and jays, cooper and sharp-shinned hawks, and last, but not least, the black snake.

HOW TO ATTRACT THE BIRDS

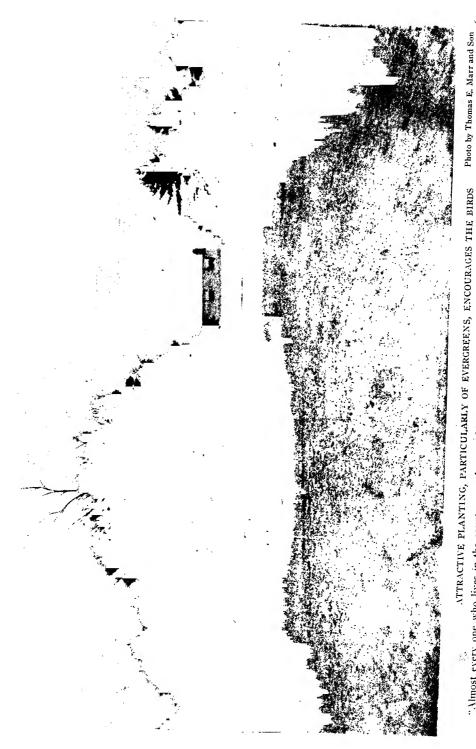
To sum up, if we are to attract birds in summer, we must furnish them with proper nesting sites, cover, food, and also water; and if we want to keep them in winter, we must again furnish them with cover and food, and always protect them from their enemies.†

The most important factor in attracting birds is the supplying of cover suitable for their wants. With this properly done, except in the case of birds that nest about buildings or in holes, nature will supply the nesting sites, as well as take care of the food supply, except in winter.

At "The Pines," my place in Newton Center, Mass., we have had for eight years under close observation about 44 acres, comprising three acres of lawn dotted with a few old apple trees, six acres of wet meadow, which are allowed to grow up with tussocks of grass, cedars, alders, wild roses, and the like, and the remaining 35 acres divided in two areas of about equal size. The first of these areas, that about the house, is covered with a growth of pines, hemlocks, cedars, birches and various other deciduous trees, among which we have taken pains to cultivate suitable coppice and undergrowth, while the second area, covered with deciduous woods, is, on account of a fire that ran through it a number of years ago, almost devoid of the smaller evergreens or protecting coppice and undergrowth (see pages 319 and 320).

In the first of these areas (page 319) some thirty different species of birds

† A useful book that every one should read who, is interested in birds is "Methods of Attracting Birds," by Gilbert H. Trafton, published by the Houghton-Mifflin Co. of Boston, Mass.



"Mmost every one who lives in the country can do something in the way of attractive planting about their houses and grounds, and ever in more closely settled suburbs almost every place, no matter how small, can by judicious planting be made attractive to birds. Even a back yard may in its limited way, with proper treatment, of made a regular rendezvous for hirds in the vicinity" (see page 321)? Photo by Thomas E. Marr and Son



IN A JERUSALEM MARKET

This market, known as the Bab-khan-el-Zeil, is the chief one in the old Moslem Quarter. The different faiths and races in the Holy City dwell more or less apart and each patronize separate markets. Photo by American Colony, Jerusalem.



THE BRIDE, PALESTINE

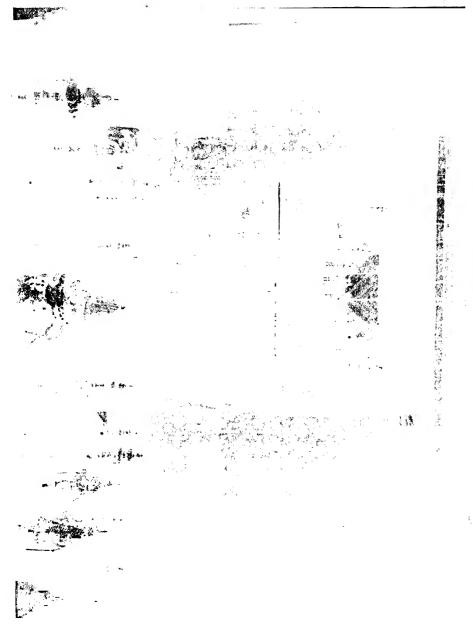
She is wearing her wedding dress, the white embroidered garment known as the *tobe*, and the large white veil to match,—the embroidery being all the work of her own hands. The head-dress of coins and the neck chain,—the marks of a married woman—are formed from a part of the money which her father received for her from the bridegroom. The average price of a bride is from \$20 to \$40. Photo by American Colony Jerusalem.



ON THE WAY TO MARKET

Like all Orientals these peasant women carry their produce to market on their heads. It is a common custom with them to take off their shoes and place them on top of their loaded baskets. The woman on the left is practising this form of economy. Photo by American Colony, Jerusalem.

BENEATH THE DOME OF THE MOSQUE OF OMAR Under this gorgeous dome, with its superb mosaics of Arabesque design, seen only in the subdued light which filters in through the ancient stained glass windows, is a great flat rock, the summit of Mount Moriah, part of the threshing floor of Ornan, the Jebusite. I Chron. xxi and xxii. (See also page 298.) Photo by American Colony, Jerusalem.



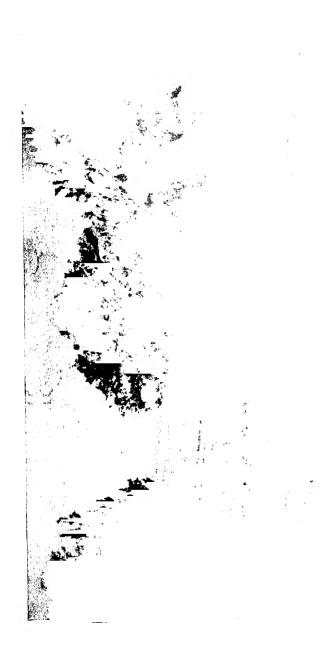
THE GROTTO OF THE NATIVITY

"To-day, in Bethlehem's church, such a cave is shown as the actual birthplace of Jesus. Its walls are covered with costly tapestries and from its ceiling hang lamps of gold and silver." The church over the grotto was built by the Empress Helena, the mother of Constantine the Great Photo by American Colony. Jerusalem



STREET SCENE IN BETHLEHEM

Bethlehem stands in the midst of a fertile district producing an abundance of wheat, barley, olives, vegetables and grapes and in consequence its market is always well supplied. Since 1834, when the entire Moslem colony was destroyed by Ibrahim Pasha after an insurrection, there have been comparatively few Moslems among its inhabitants. Photo by American Colony, Jerusalem.



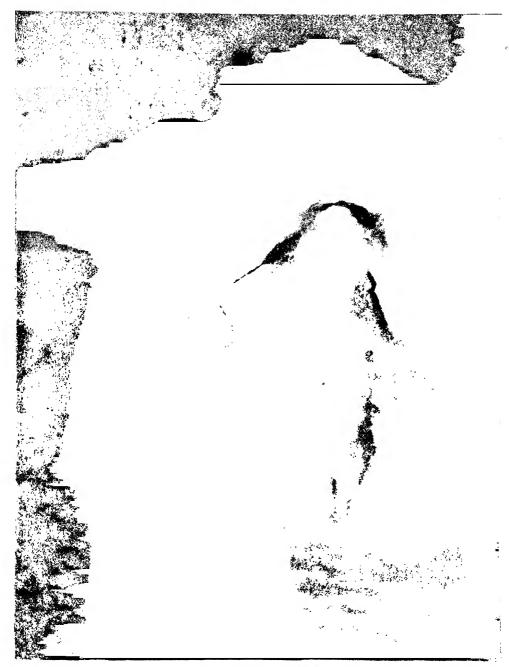
THE GARDEN OF GETHSEMANE

The garden of Gethsemane is now in charge of the Capuchins, an order of Franciscan friars belonging to the Roman Catholic Church. They tend it with the greatest care and it is one of the beauty spots of the Holy Land. It contains a few olive trees of great age, some of which are believed to have been in existence at the time of Christ. Photo by American Colony, Jerusalem.



MAKING OLIVE OIL

[&]quot;A piece of an ancient column serves as a roller, the olives being placed on a rock and crushed by passing this stone back and forth over them." Note the rich blue black color of the ripe olive. Photo by American Colony, Jerusalem.



THE SPINNING WOMAN

This woman belongs to a class like that of the people of Jericho, neither Bedouin nor peasent, but a compound of both. Her costume, like her blood, is a mixture, her dress is Bedouin in character but her head-dress is similar to that worn by the peasant women. Photo by American Colony, Jerusalem.



ON THE WAY TO THE WELL.

[&]quot;Women formerly, when passing men on the roads, would cover their faces with their hands and keep their eyes on the ground, but now when you meet them they are not shy." It will be noted that the woman on the extreme left observes the more modest custom. Photo by American Colony, Jerusalem.

us through the patient and heroic work of a group of army surgeons; we see cities like Havana and Rio de Janeiro transformed from pest-holes into municipalities where epidemic diseases are under control.

Today thousands, nay millions, of human souls living between Cancer and Capricorn are being freed from the thralldom of those terrible visitations that came periodically only a few years ago. Africa is rising up against the terrible sleeping sickness and the insidious malaria that have made it the "Dark Continent" for generations without number.

Wherever we turn we find places where once a man gambled with death when he visited them being converted into regions where good health conditions exist. Preventive medicine everywhere, and in the tropics in particular, is writing a new geography of inhabitable territory and of

commercial opportunity.

Where yesterday the barriers of disease were up against the peaceful and resource-developing invasion of capital and enterprise, there today is found health and happiness and prosperity. Where yesterday a man going to the tropics, even for a short stay, was bidden good-bye by his friends as one who stood an even chance of never returning, today men and women go there for long periods; and in some places are quite as safe as at home, and in hundreds of others only a little less so.

HOW IT ALL HAPPENED

Truly the story of how all this has been brought about is the world's most splendid exemplification of the proverb that truth is stranger than fiction. hundreds of years man stood helpless and appalled in the face of the onset of great epidemics. He saw millions of his fellow-beings visited with deaths more horrible than ever torture chamber could invent, but not knowing whence the affliction came or whither it went. He surmised and guessed, and finally saw a certain relation between dirt and disease, and gradually the elimination of dirt checked the ravages of some epidemic diseases.

Then came the microscope with its discovery of infinitesimal worlds, and with

it Pasteur and his discovery of the relation between bacteria and disease. One by one new germs were discovered, and soon medical men came to understand the methods of the transmission of most of the epidemic diseases of temperate climates.

Still no one knew the cause of the epidemic diseases most characteristic of the tropics, and without this knowledge no satisfactory superstructure of preventive tropical medicine could be reared. Tropical humanity was attacked by myriads of enemies so subtle that men did not know even that they existed, and yet so terrible that the carnage of the world's battlefields paled in comparison.

For centuries on end men had been seeking after the truth of the causation of yellow fever, bubonic plague, sleeping sickness, and allied diseases. Some of them had nearly guessed it. Sir Henry Blake tells of having seen a medical work in Ceylon, some 1,400 years old, which charged the mosquito with being a carrier of malaria. The word canopy itself was brought into the language from a Greek word meaning gnat.

WHY THE CAT WAS WORSHIPED

There were many strangely close guesses at the cause of disease in the carly history of the human race. Far back in Egyptian history the people came so near to guessing the cause of plague that they made the cat a sacred animal. They noticed that where there were cats there was no bubonic plague, and if they had only stopped to think a little further they might have seen that where there were cats the rats were scarce. But this relation did not strike them, so they went on worshipping the cat, and thinking that it was the animal's supernatural power that saved them from contracting plague.

The honor of having written the first modern work charging the mosquito with being a responsible agent in the spread of yellow and malarial fevers belongs to an American, Dr. Nott, of Mobile, Alabama. In 1848 he published a treatise upon yellow fever in which he charged the mosquito with the crime of spreading these diseases. A little later Dr. Louis Beauperthuy, studying an epidemic of yellow fever in Venezuela, also laid the



FIGHTING THE PANAMA MOSQUITO WITH OIL

These sanitary drip-barrels automatically spread oil, drop by drop, over pools, streams, and marshy places, thereby preventing the mosquito from breeding in the water. "He (Ross) proved beyond any peradventure that the Anopheles mosquito is the intermediate host, and that no one can contract malaria except he be bitten by a mosquito which has previously bitten a person suffering from that disease" (see page 347).

blame upon the mosquito, and charged that it introduced a poison similar to snake venom into the human system through the biting process.

Step by step a closer approach to the truth was made, and in 1883 Sir Patrick Manson demonstrated that the mosquito was the intermediate host of the blood parasite *filaria*.

But it was not until Sir Ronald Ross arrived upon the scene with his investigations that the real truth of the principle of insect-borne diseases came to be understood. Prior to this Laveran had succeeded in isolating the germ of malaria; and, building upon this foundation, Ross labored to ascertain the exact relation between man and the mosquito.

His efforts were rewarded with success. He proved beyond every peradventure that the Anopheles mosquito is the intermediate host, and that no one can contract malaria except he be bitten by a mosquito which has previously bitten a person suffering from that disease.

In telling of his achievement, Ross declared: "The exact route of infection of this great disease, which annually slays its millions of human beings and keeps whole continents in darkness, was revealed. The minute spores enter the salivary gland of the mosquitoes and pass with its poisonous saliva directly into the blood of man. Never in our dreams had we imagined so wonderful a tale as this."

But even Ross little dreamed when he made his great discovery that the wonderful tale his astute mind had unfolded was to be but the beginning of a long series of related discoveries which would end entirely humanity's helplessness in the face of epidemic diseases.

The medical world had hardly ceased to wonder at the work of Ross when Reed, Carroll, and Lazear, of the U. S. Army Medical Corps, proved—Lazear at the cost of his life and Carroll at the cost of a severe spell of yellow fever—that the Stegomyia mosquito plays the same role with yellow jack that the Anopheles does with malaria.

HOW MOSQUITOS, RATS, AND FLIES SPREAD DISEASE

Then came others with their discoveries that bubonic plague is transmitted by fleas carried on rats and ground-squirrels; that sleeping sickness is carried and transmitted only by the tsetse-fly; that dengue is carried by other species of mosquitoes, and more recently that the body louse is the culprit which carries typhus from man to man.

Likewise has our increasing knowledge of the principles of the spread of typhoid fever led us to the point where the only reason we contract it is because some one has been careless with the excreta that comes from persons having typhoid in their systems. We know that milk is a frequent vehicle of infection. We know, through the researches of Dr. Howard and his associates, that the house-fly,

which he has christened the "typhoid fly," constantly furnishes free transportation for germs that are seeking an entrance to some human system. We know how much water has to do with its dissemination, from the fact that in cities in Europe where there is a perfect water supply the number of cases is seldom above ten per hundred thousand people, and in America seldom above twenty per hundred thousand, while in cities where there is impure tap water the rate goes up to two hundred and even three hundred per hundred thousand population. come now to be accepted by sanitarians that in any average city of considerable population and ordinary sanitary regulations all sickness from typhoid fever over twenty cases per hundred thousand inhabitants is attributable to the water.

How much the fly has to do with the spread of the disease is illustrated by the experience of the army encampment at Jacksonville during the Spanish-American War. The lime that was carried on the feet of the flies from the latrines to the mess-tables showed that nearly all of the hundreds of cases of typhoid that infested the camp were caused by germs carried to the food of the men from the latrines. The fly has been caught red Some of handed in divers instances. them have been permitted to walk over infected material and then to walk over culture plates. In every case almost every point on which they set their feet brought forth a colony of typhoid germs. In other cases flies have been caught and given a bath in sterile water, with the result that a single bath has brought a hundred thousand germs from the body and legs of one fly.

THE SAD HISTORY OF "TYPHOID MARY"

There is one class of people who are a permanent menace to humanity. About 2½ per cent of those who contract typhoid fever live to become germ carriers. The germs like them so well that they agree to dwell in peace and harmony with their hosts; but as they go about they spread a trail of typhoid fever. An illustration of this is to be had in the case of that celebrated woman, "Typhoid Mary." She had suffered an attack of

typhoid fever, but got well. Then she returned to her duties as a cook. Six cases of the disease broke out in the family, and she left and was lost sight of for a long time. Although Dr. Soper tried to trace her, it was not until a long time afterward that she was found—this time in service in a family in a small town in New Jersey. Then her history was traced, and it was found that during the time between her two appearances she had cooked in five other homes, and in each and every one she gave the inmates the disease—27 cases in all.

TYPHOID VACCINATION

But while all sorts of prevention in the line of sanitation help to check the spread of the disease, the final blow was given to it by the discovery of the principle of inoculation for typhoid. germs of typhoid are grown in beef broth, and when they number millions for every thimbleful of the broth they are killed by the application of heat. The dead germs are then injected into the blood with a hypordermic syringe, and three doses of these dead germs are nearly always enough to make the body immune from the invasion of live germs; perhaps because they do not like to dwell amid the sepulchers of their race.

The success of vaccination for typhoid has been remarkable. In the history of hundreds of thousands of cases only a third as many vaccinated people have contracted the disease as unvaccinated people. Furthermore, the disease terminates fatally only a third as many times with vaccinated people as with unvaccinated ones. In other words, vaccination against typhoid divides the chances of dying from the disease by twelve.

Typhoid fever, however, is not so much of a tropical scourge. It does flourish in semi-tropical countries and among white people who go to the tropics. The natives seem to be rather immune from it, mayhap because the typhoid germ refuses to dwell in the same body with amorbic dysentery germs, with which so many tropical people are afflicted. But the lessons which our studies of the principles of the spread of typhoid fever have taught us fit in so beautifully in tropical

campaigns to master dysentery and cholera that they are almost as serviceable in the tropics as they are in the temperate zones. The fly carries the germ of cholera and of dysentery just as it carries the germ of typhoid. These germs use the same vehicles and travel in the same general way from the intestines of one person to the mouth of another.

The sum of all of these discoveries is that they place in the hands of mankind the power to overcome the most terrible diseases with which the tropical world has been afflicted.

CAPITALIZING THE DISCOVERIES

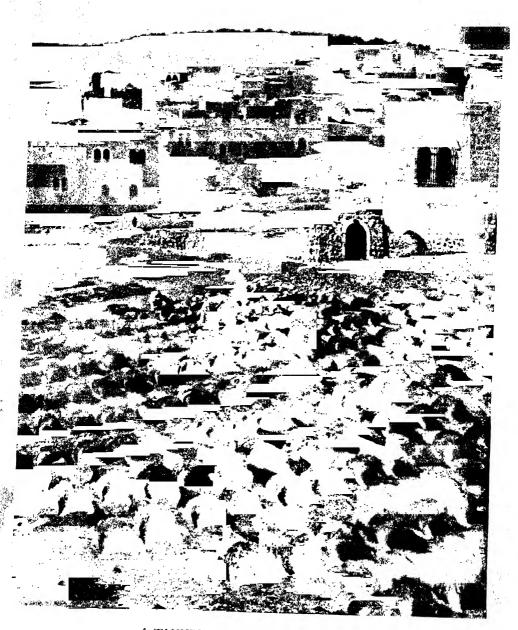
And now, having looked far into the past to see the vast need there has been for such discoveries, and into recent history to learn something of how they were made, let us journey around the tropical world today and see how they are being applied.

Of course, we go first to Panama, for there they are being applied on a scale that is extensive and with a thoroughness that shows the possibilities of such application. Indeed, no factor for putting the new science of tropical medicine to the most rigid test is wanting there.

Before the United States took control and Colonel Gorgas began to apply the lessons that had been learned in Cuba, yellow fever was endemic, malaria almost universal, bubonic plague not exceptional, and smallpox not infrequent in its occurrence. Things had been so bad that they defeated the French in their efforts to dig the Panama Canal, and when the despair of the bubble-burst boom days settled like a night over the wrecked hopes of the French failure, conditions grew even worse.

Colon was a swampy mire of filth which bade warm welcome to every germ that came along, and extended hearty hospitality to every mosquito and flea that traveled that way, bidding them all to "be fruitful and multiply"—an invitation as heartily and as appreciatively accepted as it was extended.

Panama offered a haven to every disease borne upon the wings of commerce. The water-carriers who peddled water from contaminated springs became the



A TANNERY THAT USES NO VATS

Goat skins are shown here being tanned to be sold to the city water-carriers. They are filled with oak bark and water and laid out in the tannery yard to cure.



SISTERS

"But in the Samaria district they braid their hair in two plaits, on the ends of which hang silver tubes with small coins or ornaments attached." Photo by the American Colony, Jerusalem.

The mosquito, tried and convicted in the researches of Ross and Reed, and with that sentence confirmed by the sanitary work in Cuba and elsewhere, now came to appeal to its final court for a reversal of judgment. He claimed an alibi, and he proved to the minds of thousands that he was not responsible. Hundreds tore off the screens from their houses and thousands pronounced the criminal a maligned individual. Indeed, the revulsion of sentiment went so far that men in the highest places were lining up on the side of the mosquito.

But Colonel Gorgas remained firm, and finally former Governor Magoon came upon the scene to back him up, and to give him a chance, as the counsel for the prosecution, to prove again the guilt of the accused. For three months the trial went on, and as soon as the yellow-fever mosquito was banished the epidemic terminated, and Colonel Gorgas was able to offer \$50 for each yellow-fever mosquito that could be brought him. Thus for the last time in all medical history the mosquito had his day in court and was finally and forever pronounced a creature beyond the pale of the law.

Rats and mice came in for the same stern measures of repression, and the result has been that where yesterday the grim specter of death held Panama as a favorite abode, today it has to seek other regions for its preferred haunts. Where, at the beginning of our work at Panama, all the dangerous diseases in the catalogue held high carnival and gave little heed to the despair of the people, today one may see there a sort of combination between a national tropical park and an international tropical health resort.

Every possible difficulty in the way of the accomplishment of this end was encountered when the work began, and the triumph has been as inspiring as the situation seemed hopeless.

THE VICTORY OVER YELLOW JACK

What the United States has done in Panama is no more than might have been expected in the light of what it had done in Cuba. There Colonel Gorgas, with the support of Gen. Leonard Wood, faced a terrible yellow-fever situation. In 47 years more than 35,000 residents of Havana alone had died of yellow jack. In a year or two yellow fever was banished from the island, bubonic plague was gotten rid of, and smallpox came under control.

The experience of Cuba and Panama has been duplicated throughout the tropical world wherever the lessons of those sanitary triumphs have been enforced

with proper vigor.

Consider Brazil, which in times past had come to be regarded as the natural habitat of yellow fever. In the year following the discovery of the mosquito's part in the transmission of that disease, there were 35,000 deaths from it. wonderful influx of young men from the outside world, the "conquistadors of a new era of commerce," was about to be checked and the development of the great tropical republic set back for years. But Brazil would not have it so.

Rio got busy, a perennial clean-up day was ordered, and where, in its harbor, ships once had rotted because their crews had died from yellow fever and none could be secured to replace them, there soon was not a case to be found. Thus Rio, Santos, and other Brazilian cities have become health resorts by contrast.

THE FIGHT AGAINST MALARIA

What has happened with yellow fever has not happened with malaria simply because the world does not dread it as much and will not make the thorough fight against it that has been made against yellow jack; and yet malaria has been a greater curse to humanity through more centuries than yellow fever has ever been.

Where yellow fever has slain its hundreds, malaria has slain its thousands. It has not visited mankind as a grim messenger, smiting whole nations today, and tomorrow disappearing; rather its onset has been so gentle and its reign so persistent and so general that the public mind has never been wrought to the pitch necessary to its eradication.

The fact that it results in less direct suffering and fewer proportionate direct fatalities than yellow fever has held the fears of the people in check and has permitted malaria to remain endemic in al-



Photo from American Red Cross Bulletin

THE PLAGUE IN CHINA

American Red Cross Relief Corps, showing method of protection against infection. The variety of plague during this epidemic was that known as pneumonic, and to guard against infection, both the skin and the air passages, such as the mouth and nostrils, had to be closely covered with antiseptic wrappings.

allies of suffering, and the result was a death rate of vast proportions. Stretching across the country between the two cities lay a vast expanse of untamed jungle and undrained swamp that was a paradise to the mosquito world. And then the masses of the people were hopelessly ignorant of all things sanitary and as careless as they were ignorant.

To add to the unlovely state of affairs, the ships that came in from South and Central America carried diseases with them. And so it was that one might look over the entire tropical world in vain for a place to put the new science to a severer test.

The United States was not willing to undertake the sanitation of the Canal Zone without including Panama and Colon as a part of the sanitary district, and so it was insisted that Uncle San should have perpetual sanitary control over the two major cities of the Isthmian republic, and Panama agreed.

After the international problems were settled Colonel Gorgas and his aides got busy. They built for Panama and Colon up-to-date sewer and water systems, the cost thereof to be returned to the United States in small annual payments. They cut down 16 million square yards of brush a year, drained a million square yards of swamps, cut 30 million square yards of grass, maintained nearly three million feet of ditches, emptied 300,000 night-soil cans and a million garbage cans, fumigated 11 million cubic feet of residential space, and did other things in proportion in the Canal Zone and in equal proportion in the two terminal cities.

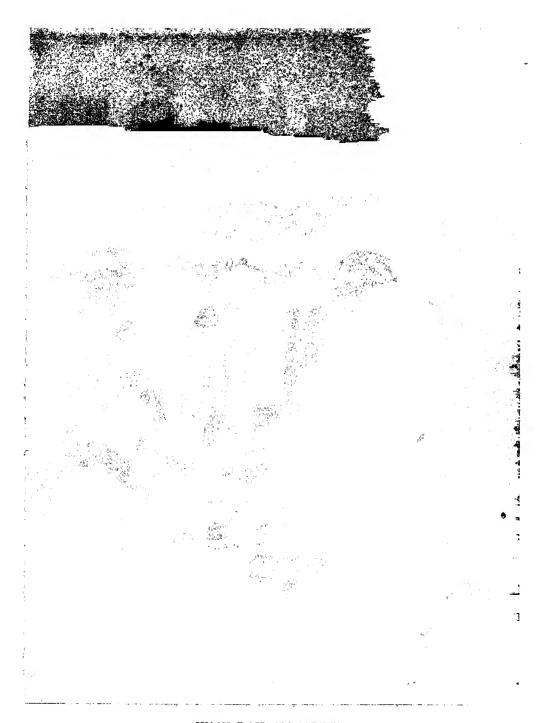
THE MOSQUITO IN THE COURT OF APPEAL

For awhile the rigid methods of the Sanitary Department met with success, and the morbidity and mortality rates both showed a remarkable decline. But then came an epidemic of yellow fever.



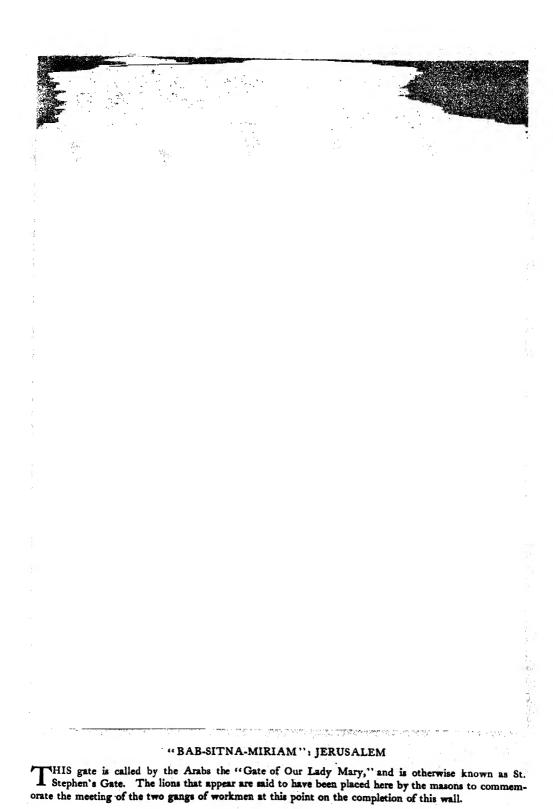
"BAB-EL-HABIS"

This street is called in Arabic the "Door of the Prison," since it leads to the jail.



WASH DAY: NAZARETH

"Unfortunately, in the Nazareth district European materials are fast displacing the handmade goods."

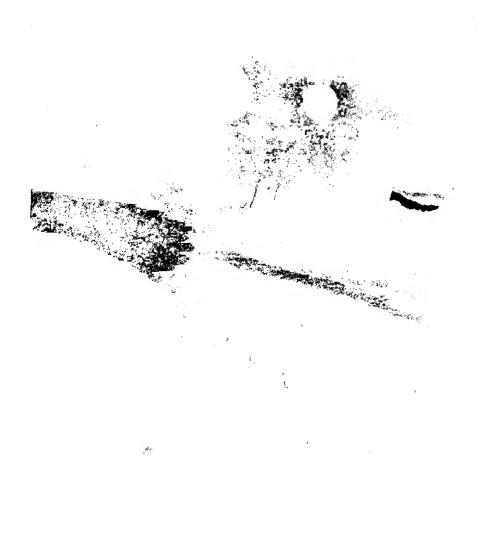


THE JERICHO MEDICINE WOMAN ALTHOUGH women are looked upon as something inferior, still, when they have signalized themselves by some special attainment, they are frequently the object of respect and reverence. The Jericho women dress like the Bedouin, but live in villages. Photo by the American Colony, Jerusalem.



THE VILLAGE WEDDING

"Towards evening the young men dress the bridegroom in his best and, with the entire village, go out into some open field where they have horse-racing and shooting." Note the palanquins on the camels from which the ladies of the family watch the festivities. Photo by American Colony, Jerusalem.



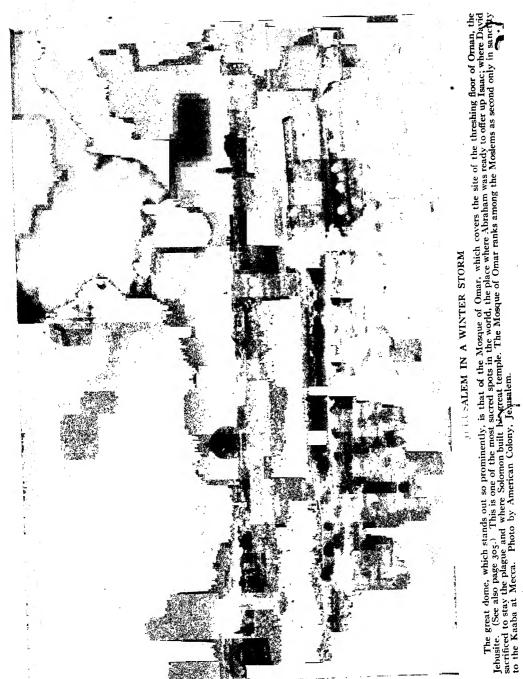
THE UPPER ROOM

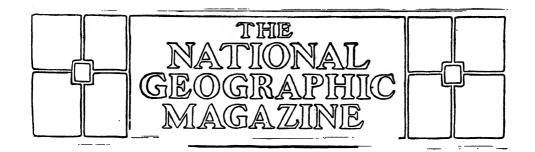
[&]quot;To make use of the rowyeh, or stable portion of the house, by human beings is not the exception but an every-day occurrence. . . . Many of these dwellings, placed as they are on ancient sites, are built over old caves or caverns which are incorporated with the lower or stable portion." (See text.) Photo by American Colony, Jerusalem.



THE VILLAGE CARPENTER

Each village in Palestine has a carpenter who repairs the ploughs and receives in exchange from each tarmer a stipulated amount of grain. Note the primitive tools and the great toe used to hold the wood. Photo by American Colony, Jerusalem.





MEXICO AND MEXICANS

By William Joseph Showalter

Especial attention is called to the map of Mexico published as a supplement to this issue of the National Geographic Magazine. It contains the latest and most accurate information of the geography of the country, and also gives the transportation routes open and in prospect, as well as the contours of altitude. The map is the highest example of the cartographer's art that has been produced with Mexico as its subject. Additional copies of the map may be obtained from the offices of the National Geographic Society. Price, 50 cents each; mounted on linen, \$1.

ERHAPS nowhere else in the world is there a country so full of contrast as Mexico. With a university established before John Harvard, Elihu Yale, or William and Mary were born, the masses of its people are hopelessly ignorant. With a hospital founded before Jamestown was even dreamed of, it is one of the most backward regions of the earth in a medical way. With natural riches greater than those of a thousand Midas's, its masses are just as poor as the proverbial church mouse. With a constitution as perfect as any organic law in the civilized world, it is a nation whose rulers always have been a law unto themselves.

Effigies of Judas Iscariot—to be burned, crunched, exploded, or hanged by the neck until dead—may be bought in the same stores that sell the latest creations of the dressmakers' and the milliners' arts from Paris. A bull ring, built of American steel and concrete, stands within earshot of the Republic's leading hotel, and the sound of the perfervid cheering of the sun-gods as they applaud their favorite matador when he

executes a brilliant pass, and the band responds with the Diana, may be wafted into the very precincts of the American Embassy itself.

Here you will see a Mexican half-breed, barefooted, wearing a dollar pair of trousers, a fifty-cent shirt, and a tendollar sombrero. There, at a single glance and within the length of a single city block, you may see an Indian cargador, a donkey, an ox-cart, a carriage, a railroad train, a street-car, and an automobile—almost every type of locomotion since Adam.

WIDE CLIMATIC RANGE

You may tread the burning sands of a tropical desert with the wet of the perpetual snow of towering mountains still upon your shoes. You may take a single railway journey of 36 hours in which the people you see at the railroad station will be dressed in four different weights of clothing.

Land of the inordinately rich and of the abjectly poor; land of the aboriginal Indian and of the twentieth-century business man; land of perpetual snow and of



"The most conspicuous thing about the male population of Mexico, so far as the masses of half-breeds are concerned, are their hats. These are bought even if their purchase does force the buyer to 'to hungry for months afterwards, for the peon is not nearly as much a slave to his haftendado as he is to his haft (see text, page 491).



Photo by Shirley C. Hulse

A VARIETY OF CACTUS WHICH IS A SOURCE OF MUCH ANNOYANCE TO STOCK AND TO RIDERS IN CHIHUAHUA, MEXICO

Any part of the bush will come away freely, and a slight touch will serve to attach almost any amount of such cactus to the person. The process of removal is usually long and painful.

unending summer—everywhere you turn there is contrast, high lights and deep shadows. Fitting indeed is Ober's beautiful apostrophe to this wonderful region:

"Mexico lies at the meeting-place of two zones—the Temperate and the Torrid—and from its geographical position, combined with its altitudes, possesses a greater variety of soil, surface, and vegetation than any equal area of contiguous territory in the world. Basking in the sunshine of the tropics, her head pillowed. in the lap of the North, her feet resting at the gateway of the continents, her snowy bosom rising to the clouds, she rests serene in the majesty of her might. She guards vast treasures of gold and silver; emeralds and opals adorn her brow; while the hem of her royal robes, dipped in the seas of two hemispheres, is embroidered in pearls and the riches of the sea.

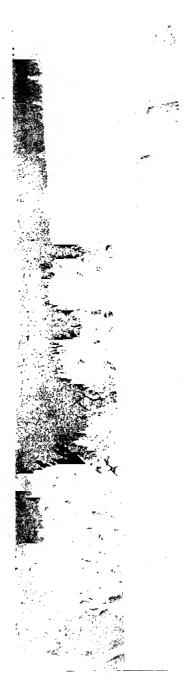
"Mother of western civilization! Cradle of the American race! A thousand years have been gathered into the sheaf of time since her first cities were built. When the Norsemen coasted our western shores she had villages and towns, white-walled temples, and spreading palaces. When the Pilgrims landed at Plymouth Rock, a hundred years already had passed since the soldiers of Cortés had battled with the hosts of Montezuma. In no country in the world can you pass so rapidly from the blazing shores of the heated tropics to the region of perpetual winter, from the land of the palm and the vine to the land of the lichen and the pine."

ONE-FOURTH AS LARGE AS THE UNITED STATES

Mexico has an area approximately onefourth of that of the United States, a



THRASHING WHEAT IN A MENICAN VILLAGE: THE VILLAGE CHURCH IS, AS USUAL, A VERY PROMINENT PART OF THE LANDSCAPE



THIS PICTURE WAS TAKEN ON ACCOUNT OF THE VERY FINE "NOPAL" CACTUS, WHICH STANDS ON THE LEFT; ASIDE FROM THE CACTUS, THE VIEW IS TYPICAL OF THE BACKYARDS IN A SMALL MEXICAN VILLAGE

Photos by Shirley C. Hulse

fourth of whose area once belonged to Mexico. It has a coast-line some 6,000 miles long, although its greatest length is less than 2,000 miles and its greatest breadth only 750 miles. Although its area is only one-fourth that of Brazil, its population is approximately equal to that of the empire of the southern continent.

Some 15 million souls live within its borders, of whom more than two-thirds

can neither read nor write.

Of the total population, only 19 per cent are white, 43 per cent are of mixed parentage, while 38 per cent still maintain their Indian blood uncorrupted. The foreign population two years ago numbered 100,000 souls, of whom 30,000 were Americans, 20,000 Spanish, and 5,000 British.

MEXICAN AGRICULTURAL POSSIBILITIES

The agricultural possibilities of Mexico, despite its vast central desert plain, are great. It has millions of acres of the finest grazing land, great bodies of land that will produce two crops of corn a year, large areas of banana lands that can match those of Guatemala and Costa Rica, coffee lands that produce coffee not only fit for the "queen's table," but used on it, rubber lands, and cocao lands—all lying accessible to good railroads and in touch with the world's markets.

Go to Yucatan, go to Colima, go to Chiapas, go to Vera Cruz, and everywhere outside the great desert you will find a soil teeming with possibilities. And portions even of the desert land, if we may judge by what we have done with our own western alkali plains, may yet be made to blossom when the irrigationist and the plant-breeder join hands.

The possibilities of the arid and semiarid regions of Mexico are disclosed at Saltillo, on the Mexican plateau between Mexico City and Laredo, Texas. The traveler who journeys from the capital to the frontier spends a night and a day traveling over a barren region, with here and there an adobe city, and with nothing but the green of the cacti to relieve the depressing brown of the desert. About twenty hours out of Mexico he

comes to Saltillo.

In a moment he passes from the desert into a broad oasis that is wonderful for its vegetation and beautiful for the air of prosperity and well-being that dwells with it. Here land that yesterday was as bare as Mother Hubbard's cupboard today is laden with all the good things that the vegetable kingdom affords. A strange combination of tropical and northern agriculture greets the eye. Most of the things which grow in our own western country flourish alongside of the crops which grow south of the Tropic of Cancer.

A trip along the Pan-American railroad, with its magnificent forests and great ancient estates, among them one on which the cattle still wear the brand of Cortes; over the Isthmus of Tehuantepec, where the tropical jungle rivals that of the Motagua River Valley in Guatemala, pronounced by Frank G. Carpenter the richest in the world, and then on up through the great Atlantic plain of middle Mexico, suggests the immense undeveloped resources of the country.

In the middle and lower altitude belts of the country the banana and the orange flourish. The excellent railroad facilities of Mexico give a good outlet to the ports at Vera Cruz and Tampico, where ships are constantly loading for European and American ports. The orangeries of eastern Mexico are nearer to the eastern part of the United States than are those of southern California, and crop failures With the among them are unknown. same methods of cultivation that are pursued in Florida and southern California. they should be a source of vast wealth to the country.

THE HOME OF CORN AND COTTON

Although the value of the corn produced in Mexico each year is greater than that of any other product, not even excepting gold or silver, the country still has to import a part of its supply. The reason is not far to seek—it is the nation-wide love for the tortilla. There are vast areas where it is easy to produce two crops of corn a year and where each crop grows with an exuberance that would delight the heart of any corn-club contestant in the United States.

It was my good fortune to travel through the region lying between the Mexican highlands and the lowlands,



Photo by Dr. C. William Beebe

This pastoral scene is where two springs—one hot, the other cold—arise close together, near the city of Colima and the active volcano of the same name, in western Mexico. This part of the country is noted for its enormous wild fig trees.

from Santa Lucrecia to Cordoba, and wherever I came across one of those little Mormon settlements which dot the prairie stretches of this region there were fields of corn to be seen the like of which may be met in but few parts of the United States.

Uncounted generations before the United States came into being the Indians of Mexico had their little patches of corn. It was the great staple of Montezuma's court, and to this day it is almost the sole support of the Mexican Indian.

There are few parts of Mexico, either in the hot belt adjoining the sea or on the table-lands between the mountains, where corn is not cultivated with success. How valuable the crop might be made when farmed in the Illinois and the Iowa way is shown by the wonderful success with which the Mormons have met when undisturbed by war.

History does not recall the time when cotton first was cultivated in Mexico. The Spaniards found it there. Indians clothed with cotton garments were first seen by Columbus along the coast of Yucatan at the very dawn of the sixteenth century. The Toltecs wrote in their sacred books that Quetzalcohuatl, god of the air, grew cotton of all colors in his garden and taught them its many uses. In the times of Cortes the Indians quilted armor of cotton, which was proof against arrows.

To this day cotton is cultivated with profit in many parts of the country. In the Laguna region it is perennial and does not require to be planted oftener than once in ten years. Some of the largest cotton factories in the world are to be found in Mexico. The great Rio Blanco mills, in Orizaba, rank with the best in England and America.

REMARKABLE MEXICAN PLANTS

Mexico probably has a greater range of remarkable vegetation than any other country in the world. The parrot fruit tree produces an odd-shaped fruit, bearing a close resemblance to green parrakeets. Evidently mindful of this striking resemblance, when the parrakeet is frightened it makes a dash for the parrot tree, where it assumes a position which makes it look like the fruit itself. So close is the resemblance that their enemies, the hawks, occasionally fly by a tree on which a dozen or more of these birds are sitting, apparently unaware of their presence.

Another remarkable tree is the "Arbol de Dinamite" — dynamite tree — whose fruit, if kept in a warm place, bursts with considerable force and a loud report, scattering its flat seeds to a surprising distance.

THE PAPAYA TREE

One of the most interesting fruits in Mexico is known as the melon zapote, or papaya. It grows wild and attains a height of as much as 25 feet. The dark-green leaves are from 20 to 30 inches long and grow at the top of an otherwise leafless trunk. The fruit would seem a cross between a cantaloupe, a pumpkin, and a watermelon. The tree begins to bear fruit when a year old, producing from 20 to 100 melons at a time, a single one of which may weigh as much as 20 pounds.

The melons contain considerable pepsin, which reacts against both acid and alkaline conditions of the stomach, and it is said that a diet which includes papaya precludes dyspepsia. Both the fruit and the leaves possess the singular property of rendering tough meat tender. When the pulp of the fruit is rubbed over a piece of tough meat the juice attacks the fiber and softens it.

The trees are well defined as to sex, and where they are cultivated but one male tree is permitted to grow in a grove of fifty or more females.

Mexico abounds in orchids, and some of the most beautiful species known in the plant kingdom are there to be found.

As one journeys through the country from the Tehuantepec Railroad to the Vera Cruz and Mexico City line he sees dozens of species of orchids on the forest trees, some of which would bring top prices in the New York market.

MEXICAN RAILROADS

No other country in the New World, south of the Rio Grande, is so well sup-

plied with railroads as Mexico. Prior to the Madero revolution it had 20,000 miles of up-to-date American railroad. At six different points lines crossed the frontier from the United States, and Laredo, Eagle Pass, and El Paso gateways handled much traffic to and from Mexico. The Mexican railroads carried 11,000,000 passengers annually at that time, and handled about 11 million tons of freight. Their total revenues amounted to about \$40,000,000.

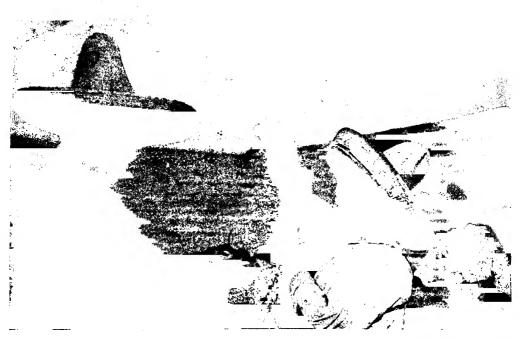
The government owns a controlling interest in the major portion of the mileage of the railroads, and is the owner of the Tehuantepec road and of the Vera Cruz and Isthmus line. A plan was on foot a few years ago to extend a branch of the Tehuantepec road to Yucatan, to connect up with the United Railways of that province. This would give every section of the country railroad communication with every other section.

Besides the Tehuantepec route there are two or three other transcontinental lines. The Pan-American Railway extends from the Tehuantepec route to the Guatemalan frontier, and this gives through railroad connection from Canada to Guatemala city. But having traveled over this route, let me advise the sea trip as one far more comfortable, even to those who are not good sailors.

From an American standpoint the Tehuantepec route is by far the most interesting of the Mexican railroads, because it is the principal prospective competitor of the Panama Canal. This road is built on the line of the proposed Eads' ship railway, from Coatzacoalcos to Salina Cruz. It is approximately 200 miles long, and crosses the continental divide above Rincon Antonio.

EADS' DREAM

How Eads could see a ship railway across those mountains is more than I can imagine. When you journey across a mountain on a railroad that is well located, and yet on which the curves have to be so sharp that the rear platform of your car and the headlight of your locomotive point in the same direction, and when this happens not once, but a dozen times, and in a 20-car mixed train, you cannot imagine, in your wildest



"HEELING" A COCK

Photo by Shirley C. Hulse

The Mexicans use a gaff, or heel, up to three inches or more in length. As contrasted to the needle-like heel which is used elsewhere, the Mexican heel is broad and razor-sharp on both edges, except that the top edge is blunted for a little ways back of the point to insure the penetration of the gaff, which might otherwise merely rip instead of cutting deep. The Mexicans sometimes wrangle and haggle for hours while arranging terms of the fights, which are usually over very quickly after they are once started. Not infrequently both cocks fall dead after the first clash.

flights of fancy, how a ship could be hauled over those mountains in a gigantic cradle.

There are many peculiarities about the Tehuantepec Railroad. It is owned by the government, but is operated by a company made up of two equal partners, the Mexican government and the firm of S. Pearson & Son. Each partner contributed half the capital of the firm, and they share the profits, the Pearson firm being the managing director.

The Mexican government owns about one-third of the stock of the American-Hawaiian steamship line, which is the principal freight producer for the Tehuantepec Railroad. Years ago these ships went around South America, from Hawaii to New York, with their cargoes of sugar. When the Mexican government decided to build the Tehuantepec Railroad, it proposed to the steamship

line to take a third of its stock, and to handle its cargoes across the Isthmus upon terms that would be more advantageous than the trip around Sout and America. It agreed to handle the business between Salina Cruz and Coatzacoalcos for one-third of the through rate, with the understanding that if this did not afford a profit to the steamship company the railroad would be willing to accept as low as a fourth of the through rate.

COMPETING WITH PANAMA

With the opening of the Panama Canal, the American-Hawaiian line will send its ships through that waterway, in spite of the fact that the Mexican government owns one-third of the line's stock, and took it in order to get the steamships to use the Tehuantepec route.

But although the Tehuantepec officials

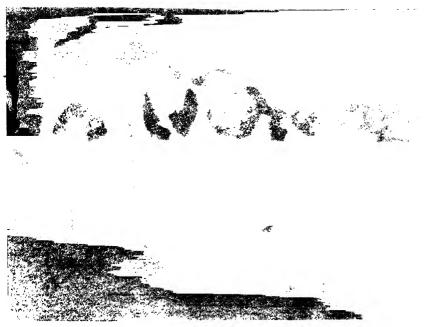


Photo by Shirley C. Hulse

MEXICANS WATCHING A COCK FIGHT

concede that on through cargo business they cannot, under any circumstances, compete with the Panama Canal, they still believe that they will not be seriously affected by the opening of the big waterway. They think that the business boom that the canal will bring to tropical America will give enough additional mixed cargo to take the place of the athrough cargo lost.

To illustrate: On a ship loaded with lumber and bound for New York from Oregon, the Tehuantepec route could not quote a rate that could compete with the canal; but on a ship that left Liverpool with mixed cargo, some bound for California, some for Hawaii, some for Peru, and some for China, the Tehuantepec route could transfer that cargo as advantageously as the Panana Canal.

Mexico spent a fortune in building port works at Salina Cruz and Coatzoalcos for the loading and unloading of the big ships that carry cargo to and from the Isthmus. At the former place a modern harbor has been made where scarcely an indentation in the shore line existed before. The inner harbor is arti-

ficial entirely, and ships now ride 30 feet above what once was the old town site of Salina Cruz. Great blocks of concrete make a sea-wall between the inner and the outer harbors. The outer harbor is formed by two great breakwaters which leave an opening about 600 feet wide out to sea. These breakwaters enclose a harbor space of about 20 acres.

Ships are loaded and unloaded with electric cranes, the cars having trap doors in their roofs. The peons often handle as much as 60 tons of sugar each a day. They are paid a standard wage, with a bonus for all above a certain amount they handle, and they certainly do work for that bonus. When the railroad was begun, wages in the Tehuantepec region were 25 cents Mexican a day; they soon reached \$1, then \$1.50, then \$2.00, and finally, \$2.25 a day.

An interesting sidelight on the policy of former President Diaz toward the upbuilding of a middle class in Mexico was afforded me by a conversation with the Vice-President and General Manager of the National Railways. He told me that General Diaz wanted to put Mexicans in



These caves have not been fully explored Lany of the crystals retain water of crystallization, and are sometimes used as hand-levels by the native miners. FLASHLIGHT PICTURE TAKEN IN THE COALCITE CRYSTAL CAVES AT NAICA, A MINING TOWN NEAR SANTA ROSALIA, CHIHUAHUA

every place that they could fill, because it would be good for the country, in the development of a middle, thinking class, to have the employees as well as the ownership of the railroads nationalized. He felt that to have Mexican conductors, engineers, telegraphers, etc., would be to assist in the establishment of a middle class, which he recognized as Mexico's crying need.

The railway manager knew by experience that the Mexican does not make as good a railroad man as the American, but he was gradually carrying out this policy at the time I was in Mexico, which was just before the fall of Diaz. It was Diaz's idea that the establishment of industries in Mexico and the employment of Mexicans in responsible positions in connection with them must eventuate in a middle class worthy of the name.

SOME MEXICAN INDUSTRIES

Mexico has many important industries, and some of the plants are the largest of their kind in the world; for instance, the Bueno Tono Cigarette Factory, of Mexico City, has a daily output of 12 million cigarettes a day. It is the largest factory of the kind in the world, and earns a 12-per-cent dividend on an investment of \$3,250,000.

The Mexican Light & Power Company, with a capitalization of \$25,000,000, operates the great hydro-electric plant at Necaxa, which is one of the largest on

the Western Hemisphere.

A few years ago there were in Mexico 145 cotton mills, with 732,000 live spindles, and employing 35,000 operators. The owners of a single chain of mills at Orizaba employed 5,000 people and turned out products valued at many millions of dollars (see also page 476).

One of the largest glycerine and soap factories in the world, with a daily output of 75,000 boxes of soap, was in operation in the very country where the Federals and the Constitutionalists have been fighting during the past few months.

All of these growing industries were demanding something in the way of intelligence from their employees and were making progress in the direction of establishing a middle class in Mexico.

THE MINES OF MEXICO

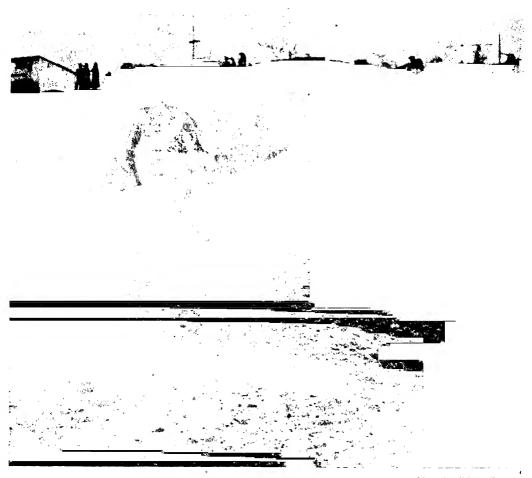
Humboldt once pronounced Mexico "the treasure - house of the world." produces one-third of the world's silver, a considerable percentage of its gold, oneninth of its lead, and one-twentieth of its The country's mineral production, exclusive of iron, coal, and petroleum, amounted to \$158,000,000 in 1910. With the exception of Campeche, Tabasco, and Yucatan, every State in the Mexican republic possesses mines, of which there are 21,000, covering 633,000 acres of mineral lands, and giving employment to half a million men. probably less than one-fourth of the mineral possibilities of the republic have been exploited. Prior to the outbreak of the Madero revolution, upward of 5,000 mining claims were registered each year.

The famous iron mountain at Durango is estimated to contain 600 million tons of iron ore, which is worth seven times the value of all the gold and silver mined in Mexico in two centuries. It is believed that this deposit was formed by the same process that made the Hudson River palisades, near New York city. A big opening was made in the earth's crust, through which this enormous mass of iron was thrust up, and piled high above the surrounding territory. No one knows how deep this iron mass penetrates. It is nearly a mile long, more than a third of a mile wide at the base, and some 700 feet high. An American smelter company has erected works to utilize this

iron.

The Santa Maria graphite mines are the largest and most important in the Western World. There are seven beds of graphite deposits, varying in thickness from 9 to 10 feet. They were formed from coal beds by the metamorphic action of intrusive granite. The graphite is transported to Saginaw, Mich., where it is ground up and sold to the pencil and lubricant factories of the world.

The region around the Gulf of Mexico is very rich in petroleum. Some years ago an oil company was engaged in sinking a well near Tampico. At a depth of 1,824 feet a gas explosion blew out the entire installation of machinery, and the well



A TYPICAL REVOLUTIONIST IN MEXICO

Photo by Shirley C. Hulse

This picture was taken at the request of the photographed, and the request was in no uncertain terms

took fire. It burned unchecked for three months, during which time 10 million barrels of oil were consumed (page 490). Hot salt water gradually replaced the oil.

The Mexican Eagle Oil Company, at Potero del Llano, struck a gusher which flowed 100,000 barrels of oil a day. A huge storage reservoir, with a capacity of 3,000,000 barrels, was established to take care of the oil pending its going to market.

It is believed that the oil fields of Yucatan, Vera Cruz, and Tampico, when once

peace is established, will go a long way toward meeting the unprecedented demand for gasoline that the automobile has created.

HOME INDUSTRIES

The delicate drawn-work of the Mexican Indian is justly famed throughout the world and deserves to rank with the finest of Spanish and Italian laces. Thousands of Indian women work at a wage of 10 cents a day, from early morning to nightfall, around the drawn-work frames



Photo by Shirley C. Hulse

THE MEXICAN FEDERAL ARMY GOES NOWHERE WITHOUT ITS WOMEN

Soldiers are supposed to be paid daily and to look out for themselves as regards food and supplies of all sorts. The women forage and cook and take the place of a regular organized commissary department. At times they take active part in battle, and they are said to leave nothing of value on the field after the fight.

which are used in Mexico. These frames are made somewhat like curtain-stretchers, and from 5 to 15 girls gather around one of them and work for days and even months on the beautiful drawn - work table-cloths which come from Mexico.

The best drawn-work is made from imported Irish linen, and the prices at which these pieces are sold, considering the work put on them, is ridiculously low. Pieces may be bought in Mexico City for \$40 which could not be duplicated in the United States for \$200. The designs are in endless variety, and each piece is so finely fashioned that it takes a woman's eye to tell which is the right and which is the wrong side.

The Indians make all sorts of small objects to attract the centavos of the tourist. The little dolls of Cuernavaca, a half-inch tall and dressed in finely embroidered raiment, are the admiration of every one who sees them. The small clay animals, perfectly fashioned and ranging from the peaceful dog to the charging

bull and the bucking mule, would do credit to the genius of many a sculptor whose name figures in the art publications of the world.

DRESSED FLEAS

But perhaps most wonderful of all are the tiny dressed fleas which may be bought in Mexico City. They are mounted in little boxes which are a little more than a quarter of an inch each in dimension. Here are a bride and groom, the former with her bridal veil and orange blossoms and the latter with his Prince Albert coat and silk hat; here are two ballet dancers dressed in true Spanish dancing costumes; here a bull fighter in full regalia; here a water-carrier with his water-jug.

Another wonderful work of the Indians is the making of feather pictures from the plumage of humming-birds, now almost a lost art. Several persons are employed on each picture, blending the various colors of the feathers together in a way requiring extraordinary patience and care.



OLD BELLS WHICH WERE MELTED AND CAST INTO CANNON BY THE FORCES OF GENERAL MANUEL CHAO AT PARRAL, CHIHUAHUA, IN 1913

The sketch of the figure to be reproduced is first made, and each artist takes charge of one particular part of the figure or drapery. When each has finished his share all of the different parts are reunited and the picture formed. Then the whole feather picture is placed on a plate of copper and gently pressed together with a sort of paste until the surface became even. Because of the splendor and liveliness of the colors, they appear even more beautiful than the paintings which they imitate.

MEXICAN DYES

The fine and fast colors made by the Indians of Mexico and their mastery of art of hand-weaving has excited the wonder of travelers for many generations. Their multi-colored serapes, in which all of the tints of the rainbow are blended with a rare harmony and a keen appreciation of color values, are perfect specimens of the weaver's art.

Many of the Indian colors are made from Mexican insects, the best known of which is the cochineal. At a time beyond recorded history the Zapotec Indians dis-

covered that the dry bodies of the female cochineal was superior even to the scarlet grain used to impart rich and lasting color to their clothes. Until 1703 it was believed that the cochineal was a seed or bloom of the plant. The insects feed on the leaves of the cochineal fig and other closely allied cacti. They remain attached to the spot on the leaf where they were hatched, and their bodies grow rapidly as they absorb the juice of the cacti, until all of their extremities are indistinguishable to the naked eye. It takes about 70,000 of them, when dried, to weigh a pound. Some are killed in ovens, which causes them to develop a grayish red color, and they are then known as the silver cochineal. The insect bears a close resemblance to the American wood-louse.

TORCHES AND LANTERNS MADE OF FIREFLIES

A remarkable insect found in Mexico is the Elater firefly. Seen by day, it is a large beetle, of a greenish-black color and about an inch long. Behind the eyes are two round transparent nodules about as large as a pin-head and filled with a



CANNON, "EL PADRE," MADE BY MEXICAN REVOLUTIONISTS FROM OLD BELLS SHOWN
IN THE PRECEDING PICTURE

luminous substance. When roused, the insect seems perfectly saturated by this luminous secretion.

Four of these fireflies will throw a fairly brilliant light, by which the pages of a newspaper may be read. They fly only after dark, and resemble fiery dragons sweeping through the air, carrying lanterns. The Indians use them as miniature torches; the men fasten them to their ankles in going through the forest, and the women wear them in their hair under a thin gauze veil.

Tiny little cages are constructed in which three or four are kept for lighting purposes. The insects congregate by the thousands in many forest trees, and, as if by a preconcerted agreement, simultaneously flash their lights, then darken them and flash them again.

CURIOUS INDIAN FOODS

The Indians of Mexico eat many curious foods. One of the most remarkable of these is made of the eggs of a species of marsh fly. This fly deposits its eggs in incredible quantities upon flags and rushes. These eggs are gathered and

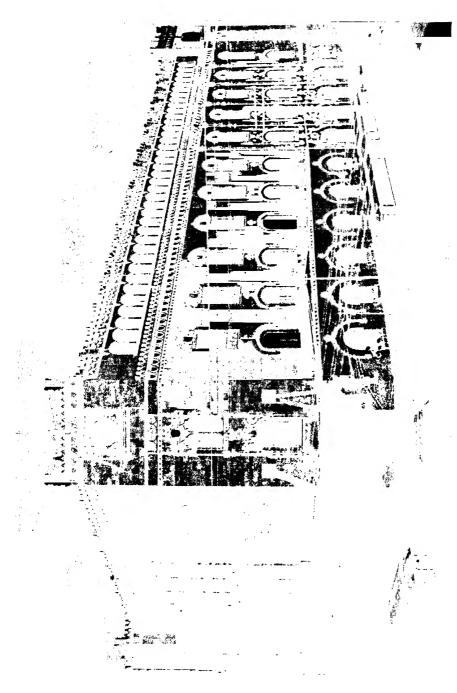
made into cakes which are sold in the markets. These little cakes are somewhat like brickbats, and the Indians enjoy a meal of them with as good a stomach as white people enjoy cheese. They call the eggs water-wheat. They resemble fine fish roe, and when mixed with corn meal and fowl eggs form a staple article of diet, particularly during Lent.

The insects themselves, which are about the size of a house-fly, are captured, pounded into a paste, boiled in corn husks in much the same fashion as tamales, and in this form are eaten.

The Indians have a systematic method of cultivating their water-wheat. They plant bundles of reeds a few feet apart, with their tops sticking out of the water. On these the insects deposit their eggs. The reeds are then removed and the eggs shaken off on a sheet.

MEXICO CITY

In all the world one cannot find a more remarkable capital than Mexico City. Situated in a valley whose floor is a mile and a half above the level of the sea, and



THE POST-OFFICE: MEXICO CITY

Photo from Alberto L. Godoy

"Mexico City is the most complete mixture of the ancient and the modern to be found in the New World. The old city might date anywhere from the tenth century, from its appearance. The new city is ultra modern, and you step from the sixteenth to the twentieth century by walking across the street. In the new part of the vertical are miles of streets, with magnificent homes on both sides, that remind one of Massachusetts are nucleous between Dupont Circle and Streets in Washington or of Riverside Drive in New York" (see text, page 489).



Photo by Shirley C. Hulse

THE BURRO-SOMETIMES SPOKEN OF AS THE MEXICAN CANARY

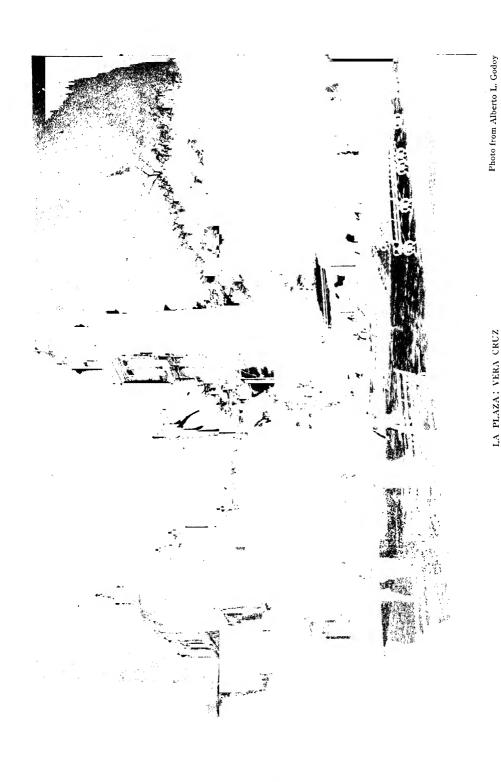
This animal is admirably suited to the needs of the Mexican peon. He is the personification of patience. About all that any one ever does for a burro is to make him work or to collect 15 pesos for his remains after he has stolidly permitted himself to be run over on a railroad. The process of making a burro work often entails what might seem to be considerable brutality. If the Mexican has any feeling for animals, he rarely exhibits such feeling in the presence of a foreigner; but the burro never seems to mind. The longer you observe him working or eating, or merely in a trance, the more surely will you wonder whether he is a stoic or whether he, too, is unfeeling as regards animals, until you hear and see him burst forth into song. Then you know that the burro is neither stoic nor clod. He has great feeling—all the feelings. He simply lacks means of expression excepting that of song, and in song he pours out all his joys and hopes, all his suffering and anguish, his longing, his very soul.

whose borders are surrounded by towering mountains; located where the beautiful volcanoes, Popocatepetl and Ixtaccihuatl, rear their snow-capped heads above the plain and stand eternal guard over it, its situation is one of rare beauty and grandeur. Its climate is mild, the temperature ranging from 35 to 75 degrees, with a mean of 65 degrees. No man sleeps without a blanket in Mexico City, nor needs an overcoat at midday.

Prior to the conquest the lakes of the Mexican Valley were extensive and the barges of the Aztecs sailed uninterruptedly from the gates of Chapultepec to Ixtapalapa. A large number of canals intersected the ancient metropolis of Tenochtitlan and connected with the lakes in the suburbs, making it a sort of new world Venice.

In 1607 the celebrated Portuguese engineer Martinez undertook to drain the Valley of Mexico by cutting a canal through the mountains. From 12,000 to 15,000 Indians were forced to do the work, which was considered complete 11 months after its inception. The work, however, was largely a failure, since it drained only one small lake and an unimportant river, leaving lakes Texcoco and Chalco still perpetual menaces to the city.

In 1879 a huge drainage canal 30 miles long was begun, which was completed in 1900, at a cost of about \$8,000,000, American gold. Its completion removed the danger of inundations from Mexico City and solved the problem which occupied the thoughts and engendered the fears of the Aztecs as far back as 1449.



Vera Cruz, like every other Mexican city and town, has its principal plaza, where the people come to promenade and to hear the military bands play. In some of the cities unaccompanied or men kelp to the right and unaccompanied men to the left, promenading in opposite directions.

This great drainage canal starts at a point east of the city and, winding its way between the Guadalupe range and Lake Texcoco, ends near the town of Zumpango, after crossing the Guadalupe River by means of a great aqueduct. The depth at the starting point is 16 feet and at the terminal 65 feet. At one place it was necessary to tunnel the Xalpan Mountain, this tunnel being about 7 miles

Mexico City is the most complete mixture of the ancient and the modern to be found in the New World. The old city might date anywhere from the tenth century, from its appearance. The new city is ultra modern, and you step from the sixteenth to the twentieth century by walking across the street. In the new part of the city there are miles of streets, with magnificent homes on both sides, that remind one of Massachusetts avenue between Dupont Circle and Sheridan Circle in Washington or of Riverside Drive in New York.

THE PARADE OF SOCIETY

The parade ground of Mexico City is the Avienda de San Francisco. short street extends from the Mexican White House to the Alameda, and is only about 24 feet from curb to curb. Here, at the approach of twilight, every smart equipage in the capital comes. the one side of the street and up the other side moves the procession at a slow walk, while everybody looks at everybody else.

It is not bad manners to look at the beautiful ladies and their large families of children—rather it would be distinctly bad manners not to, for this is a parade both for seeing and being seen. Even the moving-picture playhouses are provided with balconies, where the patrons may go between reels to watch the passing show.

Once the government, back in the days of Diaz, when no hand dared dispute its authority, ordered the parade to move down Avienda de San Francisco and to return via Cinco de Mayo street, but that took the privilege of seeing the returning crowd away from those going in the opposite direction, and even the firm hand of the law couldn't overrule the order of

society; so that even now, in the days of revolution, the parade still goes down one side of Avienda de San Francisco and up the other side.

As Avienda de San Francisco unites the old and the new cities, so does the Cinco de Mayo (Fifth of May) unite the cathedral, stateliest of all the religious edifices on the continent, with the theater, most beautiful, although unfinished, of all the amusement places in America. Cinco de Mayo is the Wall Street of Mexico, and the buildings which line it are modern in every respect.

The Paseo de la Reforma, extending from Chapultepec to the Avienda de Juarez, a short avenue connecting the Paseo with Avienda de San Francisco, is one of the finest driveways of the world. Passing through the new city, with two driveways divided by a lane of tropical trees and flowers, with here and there a beautiful circle and a splendid monument, there is nothing in the New World or the Old that surpasses it. The most magnificent mornings anywhere to be found smile down on it winter and summer, and no traveler who ever drove up the Paseo de la Reforma in the forenoon can forget that drive, even though he has seen all the famous avenues of the world.

The city is full of interesting places. Whether it be the cathedral, which rears its majestic towers to heaven on the very spot where the sacred temple of the Aztecs stood, and where tens of thousands of human beings were sacrificed to the sun; whether it be the Hospital de Jesus, built on the site where Cortes and Montezuma first met, and supported to this day from the revenues of the estate of Cortes; whether it be the Jockey Club, housed in the beautiful House of Tiles; whether it be the bronze equestrian statue of Charles IV of Spain, declared by Humboldt to be second only to the statue of Marcus Aurelius at Rome, or whether it be Chapultepec, with its memories of the American triumph in Mexico, there is no place with more attractions from a historic standpoint than Mexico City.

A PRACTICAL CHARITY

The national pawn shop is one of the unique institutions of the capital. It was



AN OIL WELL NEAR TAMPICO

One of the most spectacular sights in the world is a great oil gusher on fire. When the second Dos Bocas well was being drilled, without warning the stream was tapped at 1,800 feet, and before the men could put the fire out of the drilling engine the gushing oil spread over the ground and took fire from the engine. It was estimated that from 60,000 to 75,000 barrels of oil were consumed each day for nearly two months. The cost of extinguishing the fire and capping the well was \$3,000,000. During the height of the fury of the fire the flames reached an elevation of 1,400 feet and a width of 75 feet. Newspapers could be read at a distance of 17 miles, headlines at 33 miles, and ships could see the fire 100 miles away.

founded by Pedro Jose Romero de Terreros, the owner of the fabulously rich mines at Real del Monte. Here money may be borrowed on chattels at very low rates of interest, and everything is pledged, from a pair of cock's spurs to an automobile and from a silver ring to an iron safe. The smallest loan made is 12 cents and the largest \$4,000.

The clerk who makes the loan must repay it out of his own pocket if the pawn is not redeemed or cannot be sold for a sum equivalent to the loan. Unredeemed pledges are marked with prices at which they will be sold, and every five months this price is marked down lower, until it finds a buyer, or until the point is reached where the clerk must pay the loan and take the pawn himself.

About 40,000 articles are pawned each month. The interest on loans amounts to about \$20,000 a month. All profits go to the extension of the business.

From the American standpoint burial customs in Mexico are very strange. A grave may be rented in perpetuity or for a term of years. If the latter option is taken and the rent is not paid promptly at each recurring period, the bones of the occupant are ejected and thrown upon a great bone pile. These bones from time to time are cremated.

At Mexico City's great city of the dead, where 100,000 people have been buried, there is a cave which contains hundreds of tons of human ashes. The Mexican law forbids services at the grave since the separation of church and state under Benito Juarez.

Nothing is more heartrending than to witness a funeral of a child among the poor, and infant mortality is terribly high among them. Too poor to buy a coffin, they must content themselves with renting one. They place their own child in it, the husband takes it upon his shoulder, and together the family march to the grave, where the child is removed from the coffin and put into the ground, with nothing to protect it from the cold earth but its little cotton shroud. Those who are better off use a street-car hearse and buy coffins for their dead.

THE MEXICAN PEOPLE

The most conspicuous thing about the male population of Mexico, so far as the masses of half-breeds are concerned, are their hats. These are bought even if their purchase does force the buyer to go hungry for months afterwards, for the peon is not nearly as much a slave to his hacienglado as he is to his hat.

At one time the brims of the Mexican sombrero got so wide that the hats had to be tipped sidewise to be gotten into the cars, so the government resorted to a tax of \$1 for each 4 inches of brim above a certain width.

Grandiloquent promises and exaggerated courtesy is the characteristic of the people. To be "muy simpatico," heartily congenial, is the first law of their social code. Everybody puts his house at your disposal; it is yours. But nobody means even to entertain you as his guest unless he says so in as many words. If you admire a piano, a watch, a house, or a hacienda, it is yours instantly, although you never get it.

The Mexican loves companionship. When he meets an old friend he hugs him to his heart, figuratively and literally, and with many pats upon his back calls him the friend of his youth. He bows whenever he enters a public place, ostensibly to the person nearest the door, but in reality to the whole crowd.

Beggars flourish everywhere, and of all the woe-begone, bedraggled, miserablelooking creatures on the face of the earth, commend me to the Mexican beggar. "Un centavo, señor," rings in your ear Begging and looking day and night. wretched with them is an art whose mastery they begin to strive for while still babes in arms. They invoke the blessings of the saints and the love of God upon vou when asking for alms and when receiving them, and the only way that yet has been discovered to get rid of them is to say "Pardoneme por Dios"—"Pardon me in the name of God." That is even a better way and a much more satisfactory one than calling the police.

Once I was passing through a little town above San Luis Potosi, when I saw a bunch of little half-breeds ranging from

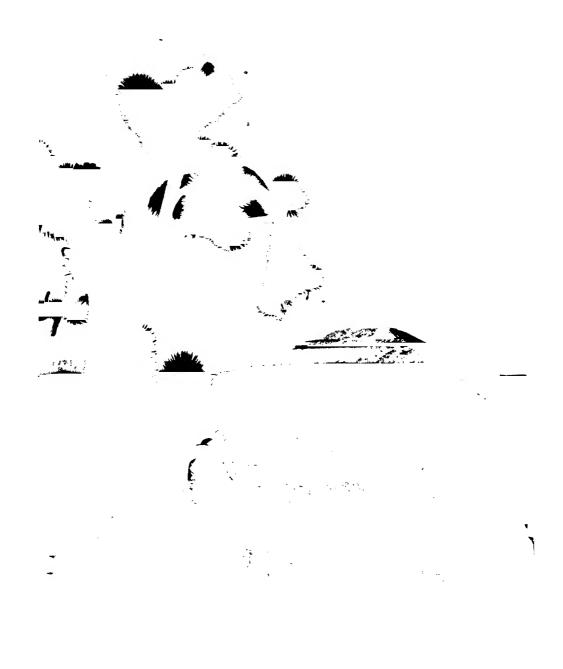


Photo from Alberto L Godoy

THE PYRAMID OF THE SUN: SAN JUAN, TEOTIHUACAN, NEAR MEXICO CITY

"The monuments left by the Aztecs and their predecessors in Mexico tell of a surprising ancient civilization . The Pyramids of the Sun and Moon near Mexico City while not as large as those of Egypt bear wonderful inscriptions" (see text, page 493)

ten years down to a baby about a year old. I gave the baby a "cinco centavo" piece, and right before my eyes a little scoundrel about eight grabbed it away from the baby and ran. I tried the same experiment in several other places, with about the same result. Mexico is the only place I have ever visited where they steal from the babies.

Mexico is a land of holidays. Counting Sundays, there are 131 on the Mexican calendar, and it is asserted that more than half of the people observe them all. There are 52 saints' days, 15 solemn feast days, 3 holy days, and 6 family feast days. On certain of these days all Mexico takes to the festival, and it usually requires from one to three days for the peons to sober up and get back to regular work again.

A SPLENDID ANCIENT CIVILIZATION

The monuments left by the Aztecs and their predecessors in Mexico tell of a surprising ancient civilization. Where once the Americans and the Mexicans engaged in deadly combat at Churubusco, and where until recently they fraternized at the beautiful Country Club long years before the astronomical observatory at Uranlenborg was built, there arose an Aztec astronomical observatory. Aztecs fixed their year with a determination of the actual time between the equinoxes more accurate than that of the Alexandrian scholars who made the Julian calendar. The latter calendar today is some 13 or 14 days out of accord with the seasons, while the Aztec calendar is only a few hours out of agreement with the equinoxes. They wrote their calendar on a great circular stone 22 feet in diameter, 3 feet thick, and weighing some 24 tons. The inscriptions on it have been worked out and the Aztec system of time reckoning ascertained.

The Sacrificial Stone, containing a carved portrayal of the rights of sacrifice of the Aztecs, is also to be found in the National Museum, and a copy of it is in

our own National Museum. Tens of thousands of victims were offered up on this stone to the sun-god of the Aztecs, the principal part of the sacrificial rite being the plucking out of the yet-beating heart of the victim and holding it up to heaven.

The Pyramids of the Sun and Moon, near Mexico City, while not as large as those of Egypt, bear wonderful inscrip-The Chinese Minister to Mexico declares that one of these inscriptions occurs on the majority of tombs in China.

From the ruins of Palenque, known to have existed before the coming of Columbus, there was taken some years ago a tablet which shows, in bas-relief, two Indians standing in reverential attitude before a cross.

The earliest people who seem to have left any trace of their occupancy of the land in Mexico were the Toltecs. They were followed by the Chicemecs, called the barbarians of the North, and believed by some to have been the progeny of a race of people who came to the American continent either by way of the frozen Bering Straits or were borne across the seas by the Japan current.

Whether viewed from the standpoint of its past, contemplated from the standpoint of its present, or considered from the standpoint of its future, Mexico is now the great question-mark of the Western World. It will be a long, long climb until its population, four-fifths Indians and half-breeds, will reach that point in their national destiny where they can possess a government like our own. It will be years before the tragic days of the present can be wiped out and before the uncounted riches of its wonderful mineral and agricultural resources can be fully capitalized.

But somehow, some day, Mexico will find that peace that is based on a united desire for peace and a united purpose to have it, and then Mexico will go forward as our own country has gone forward in the last fifty years.

BIRDS OF TOWN AND COUNTRY

By HENRY W. HENSHAW

CHIEF OF THE BIOLOGICAL SURVEY

The 64 colored pictures of common birds of the United States, which illustrate the following article by Dr. Henshaw, were prepared especially for the National Geographic Magazine by the artist-naturalist, Louis Agassiz Fuertes, and represent many months of work by him and by the engraver and printer. As in the June, 1913, number, the Geographic printed a collection of 50 birds in colors, also by Louis Agassiz Fuertes, with text by Dr. Henshaw, it has now given its readers, at the cost of many thousands of dollars, a complete pictorial description of the LLI more common birds of our country.

of the 114 more common birds of our country.

The Magazine has received so many requests for separate copies of the article printed last year that arrangements have been made for binding substantially in one volume both of the above articles; also the article by Frederic II. Kennard, "Encouraging Birds Around the Home," with 36 illustrations, which was printed in our March, 1914, number, and the original contribution, "Our Greatest Travelers: Birds that Fly from Pole to Pole; Birds that Make 2,500 Miles in a Single Flight," by Wells IV. Cooke, in our April, 1911, issue. A limited number of copies of this valuable collection, substantially bound in cloth, may be obtained at the office of the National Geographic Society at \$1.00 each (bound in leather, \$2.00).

ROM very ancient times birds have appealed to the interest and imagination of mankind. They have furnished themes for innumerable poets, have appeared in many guises in primitive religions, and by their flight inspired the predictions of the soothsayers of old. In these modern and prosaic times birds still continue to interest mankind, and the last decade has witnessed a marked strengthening of the sentiment toward them.

The present interest is direct and personal, and today hundreds of thousands of men and women in various parts of the country, old as well as young, are employing much of their leisure in familiarizing themselves with the birds of their respective localities. In following birds afield, in studying their habits, and listening to their songs, they bring themselves into close touch and sympathy with nature and add new zest to life—a zest, be it noted, which enriches without harm to any creature.

Would that the same could be said of the sportsman who almost invariably is at heart a nature lover, though the primitive instinct to kill is uppermost. Many sportsmen, however, who formerly followed wild creatures only to kill, have abandoned the use of rifle and shotgun, and today are finding greater pleasure in

studying and photographing their former quarry than they did in pursuing it with murderous intent. A real interest in living outdoor wild life leads naturally to a love of nature in all her varied manifestations, and this, in all lands and under all circumstances, remains a source of lasting pleasure.

A love of birds from the esthetic side, however, is of comparatively recent development and had little place among primitive peoples, who utilized birds chiefly in two ways-for food and for ornament. Feathers, especially, appealed to them for purposes of adornment, and this barbaric taste has not only survived among civilized races, but in recent years has developed to an extent which threatens the very existence of many of the most beautiful and notable species of birds in various parts of the world. No region is too remote, no forests too deep, no mountains too high to stay the plumehunter, stimulated by the golden bribe offered by the tyrant Fashion.

Happily, America has taken the lead in an attempt to restrict this craze for feather adornment, which means nothing less than the death of millions of beautiful and useful creatures. Nor are evidences wanting that other countries as well have recognized the gravity of the situation and are preparing to pass protective laws similar to those recently enacted in this country.

BIRDS ARE THE FARMERS' MOST EFFICIENT ALLIES

While birds appeal to the regard and interest of man from the esthetic side as no other creatures do, there is another and even more important point of view, and it is no doubt true that of late years interest in birds has been greatly stimulated by the discovery that they possess an economic value. Indeed, so great is their value from a practical standpoint as to lead to the belief that were it not for birds successful agriculture would be impossible.

The study of the economic side of bird life and of the relations of birds to the farmer and horticulturist have been greatly stimulated in the United States by Federal aid and supervision, and in no other country in the world have the activities of birds been so carefully investigated with reference to their practical bearing. Under the Biological Survey of the Department of Agriculture, for instance, is a corps of trained men, who study the food of birds by careful examination of the stomachs of specimens killed for scientific purposes. The information thus gained is supplemented by observations in the field, and the result is a large amount of invaluable data illustrative of the economic relations of many kinds of birds. This storehouse of information has been largely drawn upon in the following pages.

OUR COUNTRY IS PARTICULARLY FORTU-NATE IN THE NUMBER AND VARIETY OF ITS BIRDS

It would be strange indeed if our land, with its vast extent of territory, its diversified landscape, its extensive forests, its numerous lakes and streams, with its mountains, prairies, and plains, had not been provided by Nature with an abundant and diversified bird life. As a matter of fact, America has been favored with a great variety of birds famed both for beauty and for song. America also possesses certain families, as the humming-birds and wood-warblers, the like of which exist nowhere else in the world.

In considering the many kinds of

birds in the United States from the practical side, they may not inaptly be compared to a police force, the chief duty of which is to restrain within bounds the hordes of insects that if unchecked would devour every green thing. To accomplish this task successfully, the members of the force must be variously equipped, as we find they are. Indeed, while the 1,200 kinds of birds that inhabit the United States can be grouped in families which resemble each other in a general way, yet among the members of the several families are marked variations of form and plumage and still greater variation of habits, which fit them for their diversified duties.

As the bulk of insects spend more or less time on the ground, so we find that more birds are fitted for terrestrial service than for any other. Our largest bird family, the sparrows, is chiefly terrestrial, and although its members depend much upon seeds for subsistence they spend no little share of their time searching for insects. They are ably aided in the good work by the thrushes, wrens, certain of the warblers, and many other birds.

Another group is of arboreal habits, and plays an important part in the conservation of our forests, the true value of which we have only recently learned to appreciate. So many insects burrow into trees that a highly specialized class of birds—the woodpeckers—has been developed to dig them out. The bills, tongues, feet, and even the tails of these birds have been cunningly adapted to this one end, and the manner in which this has been done shows how fertile Nature is in equipping her servants to do her bidding.

The bark of trees also forms a favorite shelter for numerous insects, and behold the wrens, nuthatches, warblers, and creepers, with sharpest of eyes and slenderest of bills, to detect our foes and to dislodge them from crack and cranny.

The air is full of flying insects, and to take care of these there are the swallows, swifts, and night-hawks, whose wings and bodies are so shaped as to endow them with the speed and agility necessary to follow all the turns and windings of their nimble insect prey.

The whippoorwills, swift of wing and with capacious mouths beset with bristles, attend to the night-flying insects when most birds are asleep, while the hawks by day and the owls by night supplement the work of other birds and have a special function of their own, the destruction of noxious rodents.

Thus every family of birds plays its own part in the warfare against insects and other foes to man's industry, and contributes its share to man's welfare.

Birds would fall far short of what they accomplish for man were they not the most active of living things. It is curious that the group of vertebrates which live the fastest—that is, have a higher temperature and a more rapid circulation than any other—should be related by descent to a family of such cold-blooded creatures as the reptiles and lizards, which often go without food and hibernate for considerable periods. Very different is it with birds. Few realize the enormous quantity of food required to sustain the energy of these creatures, most of whose waking hours are spent in a never-ending search for food.

In satisfying their own hunger birds perform an important service to man, for notwithstanding the fact that the acreage under cultivation in the United States is larger than ever before, and that the crops are greater, the cost of foodstuffs continually mounts upward. Meanwhile the destruction of farm and orchard crops by insects and by rodents amounts to many millions each year, and if any part of this loss can be prevented it will be so much clear gain.

The protection of insectivorous and rodent-destroying birds is one of the most effective means of preventing much of this unnecessary loss, and the public is rapidly awakening to the importance of this form of conservation. From the farmers' standpoint, such birds as the bobwhite, prairie-chicken, the upland plover, and the other shore birds are worth very much more as insect eaters than as food or as objects of pursuit by This statement applies the sportsman. with especial force to such species as the prairie-chicken, which everywhere in its old haunts is threatened with extinction.

BIRDS CHECK RAVAGES OF DISEASE-CARRYING INSECTS

The value of birds to the farmer is plain enough, but we do not usually think of birds as having any direct relation to the public health. To prove that they do, however, it is only necessary to state that 500 mosquitoes have been found in the stomach of a single night-hawk; that in a killdeer's stomach hundreds of the larvæ of the salt-marsh mosquito have been found, and that many shore birds greedily devour mosquito larvæ. mosquitoes are known to carry the germs of such serious diseases as dengue fever and malaria, it is evident that by destroying them birds are conferring an important benefit on man. It may be added that not infrequently ticks are eaten by birds, and that the tick responsible for the spread of Texas fever among cattle has been found in the stomach of the bobwhite.

Since birds perform such invaluable service, every effort should be made to protect the birds we now have and to increase their numbers. This can be done in several ways: (a) by furnishing nesting boxes for certain species to nest in, as swallows, martins, wrens, woodpeckers, great-crested flycatchers, and others; (b) by planting berry-bearing shrubs about the farm or orchard as food for the birds in winter; (t) by the establishment of bird santuaries, where birds may be reasonably safe from their natural enemies and be permitted to live and breed in absolute security as far as man is concerned.

Here, again, the National Government, taking the lead, has set apart no less than 64 bird refuges in various parts of the United States. These for the most part are rocky, barren islands of little or no agricultural value, but of very great usefulness in the cause of bird protection. The example thus set is now being followed by certain States, as Oregon and Wisconsin. Several private citizens also have acquired islands for the purpose of making bird preserves of them; others not only prevent the destruction of wild life on their forested estates, but go much farther, and endeavor in various ways to increase the number of their bird tenants.

Efforts to protect birds on a smaller scale and to attract them about dwellings, with a view to their close companionship, are worthy of all praise, and such efforts should be far more common in this country than they are at present, particularly as the means involve little trouble or expense. The presence of trees and shrubbery near the house is of itself an open invitation to birds which they are eager to accept, particularly if the shrubbery is not too closely pruned. Birds like thick vines and tangles, in the recesses of which they feel safe from their many enemies. Suet, nuts, and other bird foods, if exposed in conspicuous places, can usually be depended on to attract birds in winter, and often avail to save many lives, especially when snow covers the ground. In summer opportunities to drink and bathe are irresistible attractions to birds and largely increase the number resorting to any given neighborhood.

Last but not least important may be mentioned the element of safety from cats. Birds and cats do not thrive in the same neighborhood.

To awaken interest in the study of our bird neighbors is the chief object of this paper. The free use of colored illustrations to facilitate identification precludes the necessity for long and detailed descriptions. As all the birds illustrating the text are from the brush of the well-known artist, Fuertes, they need no commendation, but may be permitted to sing their own praises.*

* The following birds were pictured and described in the June, 1913, number of the Na-TIONAL GEOGRAPHIC MAGAZINE: Bluebird, robin, russet - backed thrush, ruby - crowned kinglet, chickadee, white-breasted nuthatch, brown creeper, house wren, brown thrasher, cathird, mocking - bird, myrtle warbler, loggerhead shrike, barn-swallow, purple martin, blackheaded grosbeak, rose-breasted grosbeak, songsparrow, chipping sparrow, white-crowned sparrow, English sparrow, crow blackbird, Brewer's blackbird, Bullock's oriole, meadow-larks, redwinged blackbird, bobolink, common crow, California jay, blue jay, horned lark, Arkansas kingbird, kingbird, nighthawk, flicker, yellowbellied sapsucker, downy woodpecker, yellowbilled cuckoo, screech-owl, barn-owl, sparrow hawk, red-tailed hawk, Cooper's hawk, morning dove, ruffed grouse, bobwhite, killdeer, upland plover, black tern, Franklin's gull.

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Bald EagleBlack-crowned Night Heron		528
Herring Gull	. 	528
Great Blue Heron		528
Common Tern		
Great Horned Owl		~~
Coot		. 530
Wood-duck	• • • • •	. 530
Spotted Sandpiper		. 530

KINGFISHER (Ceryle alcyon).

Length, about 13 inches. Not to be confused with any other American bird.

Range: Breeds from northwestern Alaska and central Canada south to the southern border of the United States; winters from British Columbia, Nebraska, Illinois, Indiana, Ohio and Virginia south to the West Indies, Colombia and Guiana.

The cry of the kingfisher, which suggests a watchman's rattle in vigorous hands, can be mistaken for the note of no other bird; nor, for that matter, is the bird himself likely to be confused with any other species. Whether flying, perched on a branch over a stream, or diving for small fish, our kingfisher is always himself, borrowing none of his peculiarities from his neighbors. Many of his tropical brothers catch insects for a living; but our bird, early in the history of the development of the kingfisher family, discovered that fish were easier to catch and in the long run more filling than insects, and hence renounced the family habit and assumed the role of fisherman. Instead of using a hollow tree as a nest site, the kingfisher has apparently learned a lesson from the sandswallows and excavates a burrow for himself in some sandbank, usually not far from pond or stream; and you may be sure that any pond chosen by him for a haunt is well stocked with fish. The fish he kills are chiefly minnows and of small value, but the bird sometimes makes a nuisance of himself about fish hatcheries, where his skill in catching young food fish often brings him speedy doom.

RED-HEAD (Melanerpes erythrocephalus).

Length, about 9³ inches. Our only woodpecker with red head and broad white wing patch.

Range: From southern Canada to the Gulf Coast and from central Montana, central Colorado, and central Texas to the Hudson and Delaware. Generally resident, but more or less migratory in the southern parts of its range.

This strikingly marked and readily identified woodpecker is common in some localities and entirely wanting in others which apparently are equally well adapted to the bird's needs. Its habits are a combination of woodpecker, jay and flycatcher, and catching insects on the wing is a common habit. Though in general migratory, the bird is apparently indifferent to cold and other weather conditions, and winters wherever food abounds, especially where beechnuts, of which it is very fond, are plentiful. The red-head eats nearly twice as much vegetable food as it does animal, but the latter includes many destructive insects. For instance, it is greatly to its credit that it eats both species of clover beetles, the corn weevil, cherry scale and 17-year cicada. On the other hand, vigorous accusations are not wanting from various parts of the country of damage done by this species. It eats corn on the ear, and attacks many kinds of small fruits, including strawberries and apples. It is also guilty of robbing the nests of wild birds of both eggs and nestlings. It does some damage to telegraph poles by boring into them to make nests. No doubt some of these charges are well founded. For the most part they represent the occasional acts of individuals, or are local and not characteristic of the species as a whole.

RED-SHAFTED FLICKER (Colaptes cafer collaris).

Length, 12 to 14 inches. To be distinguished from its eastern relative (C. auratus) by its red mustache and nuchal band and the red wing and tail shafts.

Range: Rocky mountain region from British Columbia south to Mexico, west to the coast mountains in Oregon and Washington, and through California; largely resident.

Few birds are more widely known than the flicker, as appears from the fact, recorded by Chapman, that in the various parts of the country it appears under no fewer than 124 aliases. Though well known, the flicker is more often heard than seen, its loud call often proclaiming its presence when it is hidden among the trees. As a rule the flicker is shy and in some sections of the country it has good reason to be, since it is accounted a game bird and, as such, pursued for the table.

Though a woodpecker, the red-shaft departs widely from typical members of the tribe both in structure and habits. Notwithstanding the fact that its bill is not well adapted for boring into wood for larvæ, the bird manages to do considerable damage in the west by making holes, in church steeples, school houses and other buildings, to serve as roosting quarters. As it is nowise particular as to its domicile, it is possible materially to increase its numbers by putting up nesting boxes for its accommodation. The bird's subsistence is obtained largely from the ground, where it secures vast quantities of ants, for taking which its tongue is specially adapted; about one half its food in fact consists of these creatures. The flicker also con-sumes grasshoppers, crickets, and beetles, but it is so much of a vegetarian that the list of berries and seeds it eats is a long one, though it is not accused of taking domestic fruit.

CALIFORNIA WOODPECKER (Melanerpes formicivorus and races).

Length, about $9\frac{1}{2}$ inches. Easily distinguished from its fellows by its general black color, white forehead, throat patch, belly and wing patch.

Range: Breeds from northwestern Oregon, California, Arizona, and New Mexico south through Lower California to Costa Rica.

The California woodpecker is a noisy, frolicsome bird and by all odds the most interesting of our woodpeckers. Its range seems to be determined by that of the oaks upon which it lives and from which it draws a large part of its subsistence. In California the bird is known to many by the Spanish name, carpintero, or carpenter, and its shop is the oak, in the dead limbs of which, as in the bark of pines, it bores innumerable holes, each just large enough to receive an acorn. That the birds do not regard the filling of these storehouses as work, but on the contrary take great pleasure in it, is evident from their joyous outcries and from the manner they chase each other in their trips from tree to tree like boys at tag. In California many of the country school houses are unoccupied during the summer and the woodpeckers do serious damage by drilling holes in the window casings and elsewhere with a view to using them as storage places. As long as the acorn crop lasts, so long does the storing work go on. Meanwhile the jays and squirrels slip in and rob the woodpecker's larder. Though this woodpecker eats insects, including some harmful ones, they form less than a third of its entire fare.



KINGFISHER
RED-HEADED WOODPECKER

RED-SHAFTED FLICKER
CALIFORNIA WOODPECKER

BLACK AND WHITE WARBLER (Mniotilta varia).

Length, about 41 inches. Easily known by its streaked black and white plumage.

Range: Eastern North America. Breeds from central Mackenzic, southern Keewatin, northern Ontario, Newfoundland, Nova Scotia and New Brunswick to eastern Texas, Louisiana, central Alabama and northern Georgia, west to South Dakota; winters in Florida and from Colima and Nuevo Leon to Colombia, Ecuador and Venezuela.

A warbler in form and general make-up, a creeper by profession and practice, this readily identified species, in its striped suit of black and white, may be observed in any bit of eastern woodland. Here it flits from tree to tree or climbs over the trunks and branches, scanning every crack and cranny for the insects that constitute its chief food. Though not a lover of open country, it frequently visits the orchard, where it performs its part in the task of keeping insect life within due bounds. It nests on the ground and hides its domicile so skillfully that it is not often found. None of the warblers are noted as songsters, but the black and white creeper, as I like best to call it, emits a series of thin wiry notes which we may call a song by courtesy only. In scrambling over the trunks of trees it finds and devours many long-horned beetles, the parents of the destructive root-borers; it also finds weevils, ants and spiders.

YELLOW WARBLER (Dendroica æstiva and races).

Length, little more than 5 inches. Mostly yellow, breast and belly streaked with reddish brown.

Range: North America, breeding generally throughout its range south to California, New Mexico, Missouri and northern South Carolina; winters in Central and South America.

The "yellow bird," or wild canary, as it is sometimes called, is one of the commonest of the warbler tribe, and ranges over a vast extent of territory, being found here and there from ocean to ocean. Unlike some of its relatives, it prefers open thickets, especially of willows, to thick woodland, and often builds its pretty nest by the roadside or in garden shrubbery. Though not an expert musician, the yellow warbler sings early and often, and in zeal makes up what it lacks in quality of voice. Because its nest is easily found by the initiated, this warbler is often victimized by the infamous cowbird and is forced to bring up one, or even two, young cowbirds in place of its own rightful progeny. It is pleasant to be able to record the fact that sometimes the clever warbler knows enough, -how it knows it is another matter,-to evade the unwelcome responsibilities thus thrust upon it, and builds platform over the alien egg and then continues its domestic affairs as originally planned. Indeed cases are on record when two cowbirds' eggs have been found in a nest, each covered up by a separate layer of nest material. If this is not intelligence of a high order, how else can we characterize it? The food of this warbler consists almost exclusively of harmful insects, including the black olive scale.

(See Biol. Surv. Bul. 17, p. 20 et seq.; also Bul. 29.)

AUDUBON'S WARBLER (Dendroica auduboni).

Length, about 5 inches. Much like the yellow-rump but with yellow crown and throat patch.

Range: Breeds from central British Columbia, Alberta and southwestern Saskatchewan to our southern border, east to South Dakota and Nebraska; winters from California and Texas, south to Guatemala.

America is particularly favored by the presence of the beautiful wood warbler family, the members of which are excelled by few birds in symmetry of form, pleasing coloration and graceful motions. They are also of highly beneficial habits. No member of the wood warbler family is more characteristic of the group than this beautiful bird. In voice, coloration, and habits it is almost the counterpart of the yellow-rump of the eastern states, for which indeed it might easily be mistaken were it not for its yellow throat, the corresponding area in the yellow-rump being white. It summers in the mountains and shows off to advantage against the dark foliage of the pines. It seems to have little fear of man and in winter frequents orchards, Wherever it may be it gardens, and dooryards. keeps up an incessant hunt for its insect food, in the pursuit of which, like many others of its family, it sometimes essays the role of flycatcher, being very expert and nimble on the wing. This warbler also devours large numbers of ants, flies, scale and plant lice, and various noxious beetles and bugs.

(See Biol. Surv. Bul. 30, pp. 43-46).

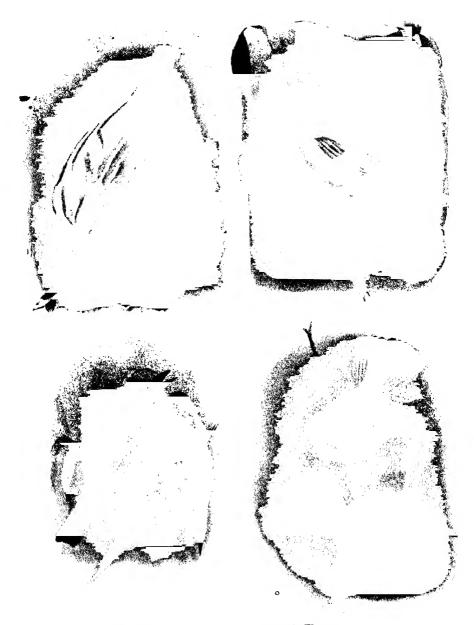
REDSTART (Setophaga ruticilla).

Length, nearly $5\frac{1}{2}$ inches. To be distinguished from other warblers by its coloration and its motions. (See below.)

Range: Breeds, from central British Columbia and eastern Canada to Washington, Utah, Colorado, Oklahoma and North Carolina; winters in the West Indies and from Mexico to Ecuador.

Its beauty of form and plumage and its graceful motions place this dainty bird at the head of our list of wood warblers—a place of distinction indeed. The bird appears to be the incarnation of animated motion and fairly dances its way through the forest. Spanish imagination has coined a suggestive and fitting name for the redstart, candelita, the little "torch bearer." The full appropriateness of the name appears as the graceful creature flits through the greenery, displaying the salmon-colored body and the bright wing and tail patches. The redstart is not unknown in some parts of the west, but it is essentially a bird of the eastern states, where it is a common inhabitant of open woodland districts. The wood warblers are not our most artful architects, and in this respect the redstart does not depart from the traditions of its kind. While it builds a rather neat and compact structure of strips of bark, plant fibres and the like, placing it in a sapling not far from the ground, the nest is not the thing of beauty one might be led to expect from such a fairy-like creature. Ornamental as the redstart is, it possesses other claims on our gratitude, for it is a most active and untiring hunter of insects, such as spittle insects, tree-hoppers and leaf-hoppers, and both orchard and forest trees are, benefited by the unceasing warfare it wages.

(See Biol. Surv. Bull. 17, p. 20 et seq.)



BLACK AND WHITE WARBLER YELLOW WARBLER

AUDUBON'S WARBLER
AMERICAN REDSTART
Female, upper; male, lower

INDIGO BUNTING (Passerina cyanea).

Length, about $5\frac{1}{2}$ inches. The male is easily identified by the rich blue color, with black wings and tail. I he female is warm brown.

Range: Breeds from castern North Dakota, central Minnesota, northwestern Michigan, southern Ontario and southern New Brunswick to central Texas, southern Louisiana, central Alabama and central Georgia; winters from southern Mexico to Panama.

The indigo bird is the brightest colored sparrow that visits the north, but one can hardly believe that the sprightly dandy, clad in his rich blue suit, is the mate of the inconspicuous brown bird that seeks assiduously to conceal herself in the leafy cover, as though a bit ashamed of the contrast between her working suit and the holidav garb of her spouse. The indigo is a frequenter of sprout land, of brushy thickets and of open woodland, and the male is fond of singing his cheerful lay from the topmost twig of a tall shrub or tree, as though challenging the world to produce his equal. For such a dainty bird, the nest is a singularly inartistic structure and very carelessly built. It is placed in the crotch of some low leafy bush and is not at all difficult to find.

The fine feathers of the male are not the only claim of the indigo bird to our interest. Its food consists largely of weed seed, but it eats many insects, including a goodly proportion of grasshoppers and caterpillars.

WHITE-THROATED SPARROW (Zonotrichia albicollis).

Length, about $6\frac{3}{4}$ inches. The white throat and yellow before the eye are its distinguishing colors.

Range: Over most of eastern North America. Breeds in much of Canada south to southern Montana, central Minnesota, central Wisconsin and in the mountains of northern Pennsylvania, New York and Massachusetts; winters south of the Ohio.

This is one of the bird lovers' favorites, as well it may be. Its beautifully variegated plumage, its jaunty ways, its familiarity and its sweet and plaintive whistle all combine to commend the bird to our interest. In the fall it comes to us in large flocks associated with other species, especially juncos and various other sparrows. The "peabody bird" is singularly prodigal of its sweet song, and the young white-throats begin to try their voices in the fall as if practicing for the more exacting demands of spring. When a number join in the fall chorus the result is singularly sweet and inspiring. Many a camper in the north woods, as he lies in his blanket under the stars, pays tribute to the sweet voices of this songster, as it is borne on the midnight air to his ears from some leafy retreat.

The food habits of this sparrow give it a place among the farmers' friends. It is a great destroyer of weed seed and is especially fond of those of ragweed and bindweed. In the cotton belt, where many white-throats winter, it includes among its insect food the boll weevil.

LAZULI BUNTING (Passerina amœna).

Length, from 5½ to 5½ inches. Male blue above, breast brownish; wing bars white. Female brownish. Range: Breeds from southern British Columbia, southern Alberta, southeastern Saskatchewan and western North Dakota to southern California and southwestern Texas; winters in Mexico.

The lazuli finch is a near relative of the indigo bunting and the nonpareil, and its habits are in a general way very similar. There is the same disparity between the dress of the sexes, the color of the female being comparatively dull and homely. The male, however, is a gay plumaged dandy in his suit of turquoise blue, and is likely to surprise the stranger who meets him for the first time, since his colors suggest a tropical setting and are somewhat out of keeping with his surroundings. Notwithstanding his fine feathers, he is not so fond of displaying himself as is his cousin, the indigo bird, but seems to think that the cover of brush and chapparral is essential to his safety. The lazuli finch is a cheerful singer, and its song may be heard at frequent intervals. This song is vivacious and pleasing and the Easterner who hears it for the first time will have no difficulty in guessing at the identity of the chorister, from the resemblance of his lay to the ditty of the indigo bird.

We know comparatively little about the food habits of this finch. It is known, however, that it is a confirmed seed eater and also devours many insects.

SLATE-COLORED JUNCO (Junco hyemalis).

Length, about $6\frac{1}{4}$ inches. Prevailing color grayish slate, belly white; outer tail feathers tipped with white.

Range: Breeds in much of Alaska and Canada and in the mountains of New York, Pennsylvania and Massachusetts, while a nearly related form (the Carolina Junco) breeds in the southern Alleghenies; winters throughout the eastern states to the Gulf.

Only one junco inhabits the eastern United States. but several species live in the west. All of the members of the group resemble each other in a general way and all have similar habits. Most of us know the junco only in the fall and when, after having summered in the mountains of the more northern districts, the birds gather in large flocks and forsake high altitudes for more congenial surroundings. The junco associates with other sparrows, usually far outnumbering them, but its slate-colored plumage and white tail feathers reveal its presence unmistakably. Its familiar "tsip," may be easily recognized among the medley of notes, but its low sweet song is to be heard at its best only in its alpine home. Nevertheless, as the late migrants shape their course for the northern woods. it is not uncommon to hear the males of a flock burst into song, as if they really could not be content to remain silent any longer. When snow is on the ground the juncos are often hard pushed for food and on such occasions a flock will readily respond to an invitation to visit the dooryard and dine on table crumbs or small seeds of any kind.

The junco is one of our most persistent grass and weed seed eaters and in winter and spring seeds constitute much the greater part of its fare. Taking the year around about one-fourth of its food consists of insects, including leaf beetles, weevils, caterpillars, grasshoppers and many others.

(See Biol. Surv. Bul. 15, pp. 80-82.)



Indigo Bunting
Male, upper; female, lower
WHITE-THROATED SPARROW

LAZULI BUNTING
Male, upper; female, lower
SLATE-COLORED JUNCO

BLACK FLYCATCHER; PHAINOPEPLA (Phainopepla nitens).

Length, about $7\frac{1}{2}$ inches. The glossy black color and marked crest of the male and the brownish gray of the female, also crested, distinguish this species.

Range: Breeds from central California, Nevada, Utah, and southwestern Texas southward; winters from southern California southward.

Though a distant relative of the cedar bird, the phainopepla differs markedly from that species both in appearance and habits. It is known to few, for it lives chiefly in the desert country of the southwest. though it is not wholly a stranger in the parks and gardens of that region. When flying the white wingpatch becomes conspicuous and distinguishes the bird from all others. In the fall it is not unusual to find it in loose flocks the members of which are drawn temporarily together, perhaps by the abundance of some favorite food. Like the cedar bird, it is essentially a berry eater, and in California sometimes makes free of the cherry crop. Its chief dependence, however, is the mistletoe, the mucilaginous berries of which delight it, as also do those of the juniper and pepper. Its partiality for mistletoe is probably the bird's worst trait, as it distributes the seeds of this pernicious parasite to the detriment of many fine oaks and sycamores. It eats many insects, principally ants, and has the habit of perching on a tall shrub, from which it sallies forth after flying insects, thus simulating a flycatcher. It is this habit which has given the bird its common name. The phainopepla has a variety of call notes and a very pleasant song.

YELLOW-THROATED VIREO (Lanivireo flavifrons).

Length, about 6 inches. Its green upper parts and bright yellow throat and upper breast are its identification marks.

Range: Breeds from southern Canada south to central Texas, central Louisiana and central Florida; winters from southern Mexico through Central America

By no means so common as the red-eye, the yellowthroat inhabits the same kind of woodland tracts and like it may often be seen, and still oftener heard, in the trees that shade the village or even the city streets. It is, however, much less common in such places since the advent of the English sparrow, having been driven away by that little pest. Its song is much like that of the red-eye, yet it has a rich throaty quality quite foreign to the notes of that tireless songster and far superior to them. Neither this, nor indeed any of the vireos, ever stem to be in a hurry. They move quietly through the leafy covert, scanning the most likely lurking places for insects, pausing now and then to sing in a meditative manner, then renewing their quest. All of which is as different as possible from the busy, nervous movements of the wood warblers, that seem ever in haste as though time were much too precious to waste.

The food of the vellow-throat consists of a large variety of insects, including caterpillars, moths and beetles, and also those well-known posts, flies and mosquitoes. It also eats the plum curculio.

RED-EYED VIREO (Vireosylva olivacea).

Length, about $6\frac{1}{4}$ inches. The slaty gray erown enclosed by narrow black lines serves to identify this viceo.

Range: Breeds from central Canada south to southeastern Washington, southern Montana, eastern Wyoming, eastern Colorado, western Texas, and central Florida; winters in South America.

The red-eye is one of the commonest not only of our vireos but also of all our small birds, and inhabits every suitable piece of woodland throughout its territory. Its notes may be frequently heard coming from the village shade trees; city parks and streets also know it. Its most notable trait is its habit of singing almost continuously as it moves slowly through the branches, pausing now and then to pick up a caterpillar or other insect. In woods where these vireos are common its voice may be heard all the livelong day, even during the noon hours when most birds are silently resting. The nest, suspended in a V-shaped fork, is a beautiful specimen of avian architecture, and so indifferent is the bird to its location that the nest of no other bird is so frequently seen by the chance passerby.

Though fond of mulberries and sassafras berries, the red-eye eats insects by preference, and spends most of its time gleaning the branches for plant lice scales and caterpillars of various kinds. It eats such harmful beetles as the long-horned borers and weevils. I once saw a red-eye with a full grown luna moth in its bill. After vigorously beating the helpless moth on a limb to get rid of the wings the bird succeeded in reducing the enormous body to a formless mass and eventually swallowed it.

(See Bull, 17, p. 23.)

LARK SPARROW (Chondestes grammacus and sub-species).

Length, about 61 inches. The variegated head markings and white outer tail feathers distinguish this species.

Range: From western Pennsylvania and western Maryland and the Mississippi valley westward; and from southern British Columbia and southern Saskatchewan to central Alabama, northern Louisiana, Texas and south into Mexico; winters from northern California, southern Texas and southern Mississippi to Guatemala.

With some of the habits of the grass finch and, like that species, having the tail feathers tipped with white, the lark sparrow yet possesses distinctive traits of its own and after a little scrutiny can be mistaken for no other species. Its peculiar head markings have suggested the local western name of "snake bird." although the reason is not quite obvious. The lark finch is usually very abundant where found at all, and inhabits the open country, prairie, plain, and desert. It is often to be seen runding along the dusty roads or perching on the roadside bushes and fences. It is a really fine songster and the possession of a musical voice has led to its capture and sale as a cage bird.

It has peculiar claims on the interest of the western farmer since it is to be classed in the front ran't of sparrows as a destroyer of grasshoppers. Thes harmful insects and others constitute about a third of its food for the year, while weed seeds of great variety form the other two thirds.



BLACK FLYCATCHER OR PHAINOPEPLA Female, upper; male, lower YELLOW-THROATED VIREO

RED-EYED VIREO LARK SPARROW

MARYLAND YELLOW-THROAT (Geothlypis trichas and variety).

Length, about 5½ inches. Mostly green above, yellow below. Distinguished from other warblers by broad black band across forehead, bordered narrowly with white.

Range: Breeds from southern Canada to southern California, Texas and Florida; winters from the southern United States to Costa Rica.

This little warbler is common throughout the eastern and southern states, frequenting thickets and low bushes on swampy ground. He is not a tree lover, but spends most of his time on or very near the ground, where he hunts assiduously for caterpillars, beetles and various other small insects. Among the pests that he devours are the western cucumber beetle and the black olive scale. He has a cheery song of which he is not a bit ashamed and, when one happens to be near the particular thicket a pair of yellow-throats have chosen for their own, one has not long to wait for vocal proof that the male, at least, is at home. The yellow-throat has the bump of curiosity well developed and if you desire a close acquaintance with a pair you have only to "squeak' a few times, when you will have the pleasure of seeing at least one of the couple venture out from the retreat far enough to make sure of the character of the visitor.

YELLOW-BREASTED CHAT (Icteria virens and sub-species).

Length, about $7\frac{1}{2}$ inches. Its size, olive-green upper parts and bright yellow throat, breast, and upper belly distinguish this bird at a glance.

Range: Breeds from British Columbia, Montana, Wisconsin, Ontario and southern New England south to the Gulf States and Mexico; winters from Mexico to Costa Rica.

The chat is one of our largest and most notable warblers. It is a frequenter of brushy thickets and swampy new growth and, while not averse to showing itself, relies more upon its voice to announce its presence than upon its green and yellow plumage. Not infrequently the chat sings during the night. The song, for song we must call it, is an odd jumble of chucks and whistles which is likely to bring to mind the quip current in the West, "don't shoot the musician; he is doing his best;" in this same charitable spirit we must accept the song of the chat at the bird's own valuation, which, we may be sure, is not low. Its nest is a rather bulky structure of grasses, leaves and strips of bark and is often so conspicuously placed in a low bush as to cause one to wonder how it ever escapes the notice of marauders fond of birds' eggs and nestlings.

The chat does no harm to agricultural interests but on the contrary, like most of the warbler family, lives largely on insects, and among them are many weevils, including the alfalfa weevil, and the boll weevil so destructive to cotton.

(See Biol. Surv. Bul. 17, p. 18 et seq.; also Circular 64, p. 5.)

OVEN-BIRD (Seiurus aurocapillus).

Length, a little over 6 inches. Above mostly olive green; below white, breast and sides streaked with black.

Range: Breeds from southern Mackenzie, Ontario, southern Labrador and Newfoundland south to Wyoming, Kansas, southern Missouri, Ohio Valley and Virginia; also in mountains of Georgia and South Carolina; winters in southern Florida, southern Louisiana, Bahamas, West Indies, and southern Mexico to Colombia.

The oven-bird is one of our best known birds and one the woodland stroller is sure to get acquainted with, whether he will or no, so common is it and so generally distributed. In moments of eestacy it has a flight song which has been highly extolled, but this is only for the initiated, its insistent repetition of "teacher, teacher, teacher," as Burroughs happily phases it, is all the bird vouchsafes for the ears of ordinary mortals. Its curious domed-over grass nest is placed on the ground and is not hard to find. The food of the oven-bird does not differ greatly from that of other warblers, notwithstanding the fact that the bird is strictly terrestrial in habits. It consists almost exclusively of insects, including ants, beetles, moths, span worms and other caterpillars, with a few spiders, millepods and weevils.

(See Biol. Surv. Bul. 17; also yearbook for 1900, p. 416.)

CEDAR WAXWING (Bombycilla cedrorum).

Length, about 7½ inches. Known from every other American bird, except its larger cousin, the Bohemian waxwing, by its crest, grayish brown upper parts, yellow tail band and sealing wax-like tips to secondaries and, sometimes, to tail feathers.

Range: Breeds from central British Columbia, Alberta, southern Keewatin, northern Ontario and northwestern Quebec south to southern Oregon, northern New Mexico, Kansas, northern Arkansas, and North Carolina; winters over most of United States and southward to Mexico and Panama.

In clothing the cedar bird, Mother Nature essayed her very best and reached the limit of quiet elegance. As if aware of the distinction conferred by its smooth delicately tinted plumage, the waxwing has the air of a well-bred aristocrat, and comports itself with a dignity that is very impressive. Why this beautiful creature should be denied a voice is a mystery but, with the exception of the faintest kind of a whistle and a few low notes, seldom heard, the bird is silent. But its beauty and the good it does should insure it careful protection.

Except during the nesting season, which is very late, the bird is a wanderer, moving about the country in flocks and remaining a shorter or longer time in a given locality according to the abundance of food. The waxwing is a berry cater and its local name of "cherry bird" indicates that it by no means disdains cultivated varieties. Fortunately the bulk of the fruit it takes consists of wild species, especially in winter, when cedar berries are greedily devoured. In the west it includes in its bill of fare mulberries and pepper berries. While insects constitute only a comparatively small percentage of its diet, those eaten include some very destructive species such as scales and the dreaded elm beetle.

(See Farmers' Bul. 54 (rev.), pp. 38-39.)



MARYLAND YELLOW-THROAT Female, upper; male, lower YELLOW-BREASTED CHAT

OVEN-BIRD CEDAR WAXWING

TOWHEE (Pipilo erythrophthalmus).

Length, about 81 inches. Male mostly black, belly white. Female brown. Outer tail feathers white tipped.

Range: Breeds in the United States from Saskatchewan and southeastern Canada south to Central Kansas and northern Georgia; winters from southeastern Nebraska and the Ohio and Potomac southward.

The towhee is a frequenter of second-growth and of scrub, and when the visitor enters such precincts he is pretty sure to hear the challenging cry, and to catch sight of the bird as it hurriedly dashes into some brushy thicket as if in mortal terror. The flight is hurried, jerky and heavy, as though the bird was accustomed to use its wings only in emergencies. This is not far from being the case, as the towhee sticks close to mother earth and uses its great strength and long claws to advantage in making the leaves and rubbish fly in its vigorous efforts to uncover the seeds and insects upon which it relies for food. The towhee thus literally scratches for a living as no other of our birds does, except possibly the brown thrush, and the lazy man may well pass by the industrious ant and go to the towhee for inspiration. No one waxes enthusiastic over its musical ability, but the song is given with such right good will that it is sure to satisfy the hearer as, no doubt, it does the bird himself. Seton interprets it to a nicety with the phrase "chuck-burr, pill-a-will-a-will-a." towhee includes in its bill of fare beetles and their larvæ, ants, moths, caterpillars, grasshoppers and flies, and also in Texas the boll weevil. Wild fruit and berries complete the list.

ORCHARD ORIOLE (Icterus spurius).

Length, about $7\frac{1}{4}$ inches. Our only oriole with black and chestnut markings. Female grayish olive green.

Range: Confined to eastern North America. Breeds from North Dakota, Minnesota, Wisconsin, Michigan, southern Ontario, central New York and Massachusetts south to northern Florida, the Gulf Coast and southern Mexico, west to central Nebraska and western Kansas; winters from southern Mexico to northern Colombia.

Though elad in modest garb (for an oriole) and in no respect a rival of the Baltimore, the orchard oriole has merits of his own. As his name implies, he is a lover of orchards, and I have always associated him with the glory of apple orchards in full bloom and with the delicious perfume with which the air is heavy. Amidst such surroundings, the black and chestnut livery of the orchard oriole marks him as one of the princes of our bird world. Gardens and parks also know him well, and he is not averse to swinging his nest from the trees that shade the farmer's house. His nest betrays his connection with the family of weavers, but his skill does not equal that of the Baltimore and he is content with a smaller pensile basket made chiefly of grasses. His song, like his dress, is modest, but it is exceedingly sweet, and one who hears it is sure to pause in his walk and wish that it were longer and given more frequently.

The orchard oriole is chiefly insectivorous, as indeed are all of our species.

CALIFORNIA BROWN TOWHEE (Pipilo crissalis and varieties).

Length, about 9 inches. The long tail and brown plumage with white belly distinguish these groundand thicket-loving birds.

Range: Southwestern Oregon, through California to northern Lower California.

The brown towhees, of which the California form is a good type, are characteristic of the brushy canyons of the far west, where they skulk and hide among the shrubbery and cactus much as do the common eastern towhees. Their powers of wing are not great and their long tails and heavy bodies render their flight awkward in the extreme. On the ground, however, they run with great ease and speed. In California brown towhees are common in the parks and gardens, and in every way are very much more familiar than the related towhee of the east. Like its eastern cousin, it is much addicted to scratching among leaves and rubbish. for which work its stout legs and claws are particularly adapted. The thin "tchip," which is the call note, seems out of all proportion coming from such a stout, vigorous body. The birds of this group are not fine songsters, but their simple ditties are pleasant to hear in the waste places where they are generally found.

The brown towhee is much more of a vegetarian than an insect eater, and in California Professor Beal found that 85 per cent. of its yearly food consists of fruit, grain and weed seeds.

BALTIMORE ORIOLE (Icterus galbula).

Length, about $7\frac{1}{2}$ inches. The combination of black and orange marks this bird from its fellows.

Range: Breeds from central Saskatchewan and the southeastern provinces of Canada south to northern Texas, Louisiama and northern Georgia, west to Montana, Wyoming and eastern Colorado; winters from southern Mexico to Colombia.

Lord Baltimore was signally honored when one of our finest birds was christened with his name because it chanced to carry the family colors, black and yellow. Orioles are a tropical group and the luxuriant tropical forests are bright with gleaming colors of many species of these beautiful birds. Only a few have found their way into the temperate zone, but not one of the tropical species is garbed in more tasteful dress than this exotic which has adopted the elms and sycamores of the temperate zone for its summer home. When chill November winds have stripped our shade trees of their foliage then are revealed the long, pendant nests, wrought with so much skill and patience by Madame Oriole, and we begin to realize how many of these birds summer with us. Suitable material for the oriole nest is none too easily found, and the weaver is not so fastidious that she will not accept strings and yarn of any color which are hung out for her convenience; so that at the end of the oriole season the bird lover who is willing to co-operate with a pair of Nature's weavers may fall heir to a nest made to order, so to speak.

The oriole is as useful as it is tuneful and ornamental. Caterpillars constitute the largest item of its fare, including many not touched by other birds. It cats also beetles, bugs, ants, grasshoppers and spiders. Particular mention must be made of the boll weevil, of which the oriole is a determined foe. The small amount of fruit taken by the oriole, including cherries, is insignificant when compared with the long list of harmful insects it destroys.



Townee or Chewink
Male, upper; female, lower
Orchard Oriole
Male, upper; female, lower

CALIFORNIA BROWN TOWHEE
BALTIMORE ORIOLE
Male, upper; female, lower

MAGPIE (Pica pica hudsonia).

Length, from about 18 to 21 inches. The black head and body and the white belly, white wing patches, and long tail are distinguishing features. The yellow-billed magpie is smaller with a yellow bill.

Range: A characteristic western species. Breeds from Aleutian Islands and Alaska, central Alberta, southern Saskatchewan and Winnipeg Lake south to northern Arizona and New Mexico, and from the Cascades and Sierra to western North Dakota and western Texas: resident.

There are two species of magpies, the yellowbilled being confined to California, where it is very local. In general the habits of the two are similar. "Maggie," as this bird is familiarly known in the west, possesses dual traits. He is beautiful of plumage and adds much to the interest of the landscape as he flies from field to field, his long tail extending behind like a rudder.

Of eminently sociable disposition, this bird is rarely seen alone. He prefers flocks of family size to 50 and upwards. In more ways than one the magpie is like the crow and his sagacity has developed along much the same lines. In most localities he is suspicious and wary, as he has good cause to be, for he is not a favorite with either farmer or ranchman. He is eminently carnivorous, a carriou feeder by preference, an insect eater by necessity. and he performs good service in the latter role. He cats also many wild fruits and berries, but he is an incorrigible thief and well he knows his way to the poultry yard. No sound is sweeter in "Maggie's" ears than the cackle of the exultant hen that has just laid an egg, and the hen house must be well protected that keeps him from his plunder. Perhaps his worst trait, however, is his fondness for the eggs and nestlings of small birds.

PHŒBE (Sayornis phœbe).

Length, about 7 inches. Distinguishing marks are the dusky brown color, dark brown cap and white margined outer tail feathers.

Range: Lives mainly in the east. Breeds from about middle Canada south to northeastern New Mexico, central Texas, northern Mississippi and mountains of Georgia; winters from south of latitude 37° to southern Mexico.

Few of our birds have won a more secure place in our hearts than plain little phœbe, who has no pretentions to beauty of plumage or excellence of song. For this its confiding disposition and trusting ways are responsible, and many a farmer listens for its familiar voice in early spring and welcomes it back to its accustomed haunts under the old barn. Originally building its nest on the face of cliffs, the phœbe soon forsook the wilds for man's neighborhood, and year after year apparently the same pair returns to the identical rafter in the barn, the shelter of the porch, or the same nook under the foot bridge, which they have claimed for their own for many seasons. The insistent call of "phœbe—phœbe" is as familiar as the pipe of the robin.

The phœbe has further claims to the favor of man since it is one of the most useful of birds, living almost wholly on insects, among which are many noxious kinds, as May beetles, click beetles, and several species of weevils, including the boll weevil and the strawberry weevil. As if reluctant to leave their northern home, many phœbes remain with us till late fall, and individuals may be seen lingering in sheltered places in the woods long after other flycatchers have started for the tropics.

BLUE-FRONTED JAY (Cyanocitta stelleri and sub-species).

Length, 11\(^3\) to 13 inches. Easily distinguished from its fellows by its high erest, brownish slaty fore-parts, dark blue wings and tail and blue or whitish streaks on forehead.

Range: Resident in western North America from southern Alaska and Montana to Mexico.

The blue-fronted jays, of which the Steller jay may be taken as the type, are common inhabitants of the piny woods of both the Rocky Mountain and the Sierra Nevada States. They are among the handsomest of the family, the beauty of their plumage, their long erectile crests, and their insistent voices compelling the attention of any who invade their retreats. Not being residents of cultivated districts, although they eat grain and small fruits, they do comparatively little damage. On the other hand, they do not do much good, for, although they are insect caters, insects do not constitute a large part of their food, nor are the kinds they eat very important economically. Probably their most serious fault is a fondness for the eggs and young of small insectivorous birds of which they destroy many in the course of the year. They share this failing with all other members of the family, and bird lovers must deem it a pity that such bold, dashing, handsome birds as the jays should be so destructive to small but useful birds. This habit is all the more to be deplored inasmuch as when unmolested jays readily respond to invitations to be neighborly, and willingly take up their abode near houses, where they never fail to excite admiration and interest.

WOOD PEWEE (Myiochanes virens).

Length, about $6\frac{1}{2}$ inches. Not readily distinguished by color, though darker than most other small flycatchers, and with wing longer than tail.

Range: Breeds from Manitoba and southeastern Canada to southern Texas and central Florida; winters in Central and South America.

The wood pewee is clad in such modest garb and is of such retiring disposition that, were it not for its voice, it would often be passed unnoticed even by the most observant, especially as its home is in shaded glens or deep woods. Here the wood pewce pursues its vocation with a vigor worthy of all praise, and the snap of its mandibles as they close over some luckless flying insect is often the only sound heard in the depths of the quiet forest. There is little about the habits and make-up of this, or indeed of any of the flycatchers, to suggest great constructive skill, but the nest of the wood pewee is a marvel of taste and ingenuity and, though much larger, suggests the dainty architecture of our hummingbirds. Like their fairy creations the wood pewees' nest is covered with lichens and saddled neatly across a limb.

The food of this flycatcher consists almost exclusively of insects and includes among others crane flies, beetles, dragon flies, ants, grasshoppers, caterpillars and moths of many kinds. It also devours such pests as the clover weevil, the plum curculio, the corn weevil, the rice weevil, and others nearly as harmful, and many flies, including the house fly.



BLACK-BILLED MAGPIE
YELLOW-BILLED MAGPIE
PHŒBE

Blue-fronted Jay Wood Pewee

RUBY-THROAT (Archilochus colubris).

Length, about $3\frac{3}{4}$ inches. Needs no description as it is the only hummer living in the eastern states.

Range: Breeds from southeastern Saskatchewan and central Quebec south to Gulf Coast, west to North Dakota, Nebraska, Kansas and central Texas; winters from middle Florida and Louisiana through southern Mexico and Central America to Panama.

Of the five hundred or more species of this strictly American family, the eastern United States is favored by the presence of only one, the ruby-throat. nor is this species as common as might be desired. Compared to the abundance of its kind in the far west it is rare indeed. As if afraid of being too prodigal of her gifts, Nature has denied the hummingbird song, and the harsh squeaks of these tiny sprites are far better adapted to making war than love. Truth is, the hummer has a sharp temper and not only engages in warfare with its own kind but attacks any bird, however large, that ventures to dispute its territorial rights. These are not small, for in its own estimation it is literally "Lord of all it surveys." The male is an inconstant swain and no sooner is the nest made—and in the making he takes no part—and the eggs laid than he departs, leaving the joys and cares of housekeeping to his erstwhile mate. While the nectar of flowers is eaten in large quantities, a creature so vivacious as the hummer could hardly sustain life on diet so thin, and the bird adds to its bill of fare a liberal supply of minute insects and spiders of various sorts.

WHIP-POOR-WILL (Antrostomus vociferus).

Length, about 10 inches. Not to be confused with the nighthawk, which flies by day and has whitewing bars, while the whip-poor-will is crepuscular and nocturnal.

Range: Breeds from the Atlantic to the plains, and from Manitoba and the eastern Canadian Provinces south to northern parts of Louisiana, Mississippi and Georgia; winters from South Carolina and the Gulf States to Central America.

This bird of the night, whose day begins with the going down of the sun when the nighthawk's ends, is common throughout the east in open woodlands, on the edges of which it likes to hunt. It dozes away the hours of daylight squatting on the ground among the leaves where its marvelous protective coloration affords it safety. No sooner have the shadows lengthened, however, than it becomes active and its characteristic note resounds through the forest glades. So plaintive is its cry and so mysterious its comings and goings, that in the minds of many its notes are associated with misfortune, as a death in the house near which it persistently calls. Its two eggs are laid among the leaves, needing no other protection than the cover of the mother's body. The whip-poor-will may be accounted one of our most efficient insect destroyers, as its immensely capacious mouth beset with bristles, a regular insect trap, would suggest. Among its prey it includes May beetles and moths. These two form the principal articles of food and as they are parents respectively of the white grub worm and an innumerable host of caterpillars their destruction is of marked benefit to agriculture.

RUFOUS HUMMINGBIRD (Selasphorus rufus).

Length, from $3\frac{1}{4}$ to $3\frac{3}{4}$ inches. The reddish brown body color, red and green gorget, and the notch in tail feathers serve to distinguish this species from our other hummers.

Range: Breeds from the Alaskan coast, east central British Columbia, and southern Alberta south to the mountains of central California, and southern Idaho.

One can but wonder at the hardihood of this little wanderer from the tropics in including in its summer itinerary a journey to distant Alaska. It reaches a latitude of 61°, much farther north than any other of its kind. In favored glades of the forests in the Rocky Mountains and the Sierras during the migration this and other species of hummers are to be seen literally by hundreds. The rufous hummer has temper and courage to match its fiery hues, and spends no small part of its time doing battle with its fellows. The contestants after several fierce rounds fly away not only fit but eager for another fray on the first occasion. In addition to the nectar of flowers, its standard fare, this hummer includes in its diet "honey dew," the sugary secretion of plant lice-which is deposited on vegetation. Like all other hummers it eats large numbers of minute insects which it finds inside the flowers. It is interesting to note that hummingbirds discover the flowers they frequent by sight alone and any bit of bright color in the distance is sure to attract their notice, as a bright red handkerchief on a bush or about the neck. More than once I have observed them poising within a few inches of my head evidently endeavoring to ascertain the nature of the red handkerchief I wore.

ROAD RUNNER (Geococcyx californianus).

Length, 20 to 24 inches, mostly tail. Quite unlike any other North American bird in form and color.

Range: From the upper Sacramento Valley south through California and the peninsula and from Colorado, Kansas, middle and western Texas, Arizona and New Mexico sauthward: resident.

Arizona and New Mexico southward; resident.

The name "road runner" when applied to a cuckoo may seem an anomaly to those who know only our eastern cuckoos, but in truth the road runner is anomalous in many ways. It is distinguished by curiously marked plumage, the possession of a long bill and a disproportionally long tail. As a result of its strange appearance, and stranger anties, the road runner is made the hero of many a fable. Among other wonders it is claimed that it can outrun the swiftest horse and kill the biggest rattle-snake. It is said to accomplish the latter feat by surrounding the reptile while asleep with a rampart of cactus spines on which the enraged reptile accommodatingly impales itself.

The truth is that when in a hurry this ground cuckoo can run with great speed, though as yet no official record of its best time has been made. Its food consists of a great variety of harmful insects, among which the snout beetles or weevils are conspicuous. It devours also mice, horned lizards, centipedes, land shells and small snakes; probably a young rattlesmake would fare no better than any other small snake. Its notes are difficult to interpret with words, but are not likely to be forgotten when once heard, and they are frequently uttered in the early morning from the topmost bough of a mesquite or other tree.



RUBY-THROATED HUMMINGBIRD
Male, upper; female, lower
WHIP-POOR-WILL

RUFOUS HUMMINGBIRD
Male, upper; female, lower
ROADRUNNER



PELICANS ON THE LOBOS DE AFUEVA ISLANDS, PERU

It was estimated by Mr. Coker that there were upward of 100,000 pelicans, all told, on the eastward island of the Lobos de Afuevas. At the time of the 50 little consideration. (See the article, "Wealth of a Rainless Coast," by Robert E. Coker, printed elsewhere in this number.)



ONE HUNDRED THOUSAND PELICANS

Photo by Robert E Coker

tily greater number of smaller birds Unfortunately, this great and valuable rooker. (See the article, "Wealth of a Rainless Coast," by Robert E Coker, printed elsewher Such an array of big gray birds makes a more showy effect than a vastly greater number of smaller birds unmolested for several years, was not permitted to remain undisturbed in this number.)

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VARIED THRUSH (Ixoreus nævius).

Length, about 10 inches. Its large size and dark slate-colored upper parts, black breast collar, orange brown stripe over eye and orange brown under parts mark this thrush apart from all others.

Range: Breeds on the Pacific coast from Yakutat Bay, Alaska, south to Humboldt County, California; winters from southern Alaska to northern California.

This, one of our largest and finest thrushes, is limited to the west coast, where it finds a congenial summer home in the depths of the coniferous forests, the mystery and loneliness of which seem reflected in its nature. Although the varied thrush somewhat suggests our robin, it is much shyer, and its habits and notes are very different, making it more nearly akin to the small olive thrushes. It nests in the conifers, and its eggs, unlike those of the robin, are heavily blotched with brown. Its song, a single long-drawn note, has been greatly praised, and seems entirely in harmony with the bird's surroundings, being weird and inspiring. In winter the varied thrush abandons the forest and with it many of the habits of the recluse, and visits more open districts, including ravines and even gardens, where it becomes quite familiar.

This thrush, like its smaller brethren, feeds chiefly on the ground, and its food is largely of vegetable nature, but includes a fair proportion of insects, with millepeds and smalls. Unless its habits are greatly modified by the encroachment of civilization on its domain it is not likely to be much of a factor in agricultural affairs, but it will continue to make itself useful by destroying the insect enemies of forest trees.

VEERY (Hylocichla fuscescens fuscescens).

Length, about 7½ inches. To be known from the other small thrushes by its uniform cinnamon brown upper parts and its faint brown breast markings.

Range: Breeds from northern Michigan, central Ontario and Newfoundland south to northern Illinois, northern Indiana, northern Ohio and New Jersey; and in the Alleghenies south to North Carolina and northern Georgia; winters in South

Far more retiring than either the wood thrush or the hermit, the veery must be sought in the seclusion of the swamp or swampy woodland, far from the recesses of which he rurely ventures. Much of his time he spends on the ground, for on or near it he finds his chosen fare. Though trim in form and elad in a garb of modest color as befits his nature, the veery appeals less to the bird lover's eye than to his ear. Though some of his relatives are classed among the most famous of American songsters, the veery may fairly claim place in the front rank, and his wild, mysterious and all-pervading notes touch certain chords in the human breast which respond to the song of no other of our birds.

The food of the veery does not differ essentially from that of the other small thrushes and includes a great variety of small wild fruits and insects. As it rarely visits the orchard or farm its insect-eating habits have little direct bearing on the farmer's interest, although indirectly the bird contributes its share to the beneficial work of staying the superabundant tide of insect life. It does, however, eat many weevils, and among them the notorious plum curoulio.

WOOD THRUSH (Hylocichla mustelina).

Length, about 8½ inches. To be distinguished among its fellows by its more bulky form, by the golden brown head, bright cinnamon upper parts, and the large round black spots beneath, sharply contrasting with the pure white.

Range: Breeds from southern South Dakota, central Minnesota, central Wisconsin, southern Ontario and southern New Hampshire south to eastern Texas, Louisiana and northern Florida; winters from southern Mexico to Central America.

The wood thrush finds its way to our hearts and sympathies more through its voice than its presence. and whoever has failed to hear its clear flute-like tones rising from the woodland depths as the mists of evening gather has missed a rich treat. It is no doubt true that the Hermit Thrush is a more finished performer, but that chorister reserves his music chiefly for the northern wilds while our wood thrush favors more southern lands. Moreover, the hermit is a true recluse and must be sought in the deeper forest, its chosen home, while its more southern cousin lives in comparatively open woodland and does not disdain to take up its summer residence in parks and gardens. The music of the one is for the favored few, while the song of the other is almost as well known as that of the brown thrasher.

Like most of the tribe, the wood thrush obtains its food chiefly from the ground, where it spends much of its time searching among the leaves. Insects with a small percentage of fruit, chiefly wild varieties, compose its fare. Among the insects are cutworms and other caterpillars, ants, grasshoppers and beetles, including the Colorado potato beetle. Thus the bird deserves a high place in our esteem for both esthetic and economic reasons.

BUSH-TIT (Psaltriparus minimus

and sub-species).

Length, from 4 to 4} inches.

Range: Pacific coast from southern British Columbia to the Cape Region of Lower California, and eastward to the interior of Oregon and California; nests generally throughout its range.

This pigmy among birds has many of the characteristic habits of the chickadee family, of which it is the smallest member. Extremely sociable, bush-tits move about in large flocks, occasionally in company with other birds, generally without. One moment you are alone, the next moment the trees and bushes are full of these diminutive little busy-bodies that scan you with their curious bead-like eyes as they hurry on in quest of food, keeping up the while a constant calling and twittering. Their pendant nests, often attached to oak trees, suggest the well-known structure of our hang-bird or Baltimore oriole, and are excellent specimens of bird architecture.

The few western states favored by the presence of this bird are to be congratulated, as more than half its animal food consists of insects and spiders, nearly all of which are harmful. Among the insects are many tree bugs, *Hemiptera*, which contain our most dreaded insect pests, such as the black olive scale and other scales equally destructive. The bush-tit is also a persistent foe of the codling moth in all its stages.

(See Farmers' Bul. 54, p. 44; also Bul. 30, pp.



House Finch
Female, upper; male, lower
ARKANSAS GOLDFINCH
Male, upper; female, lower

Purple Finch
Male, upper; female, lower
American Goldfinch
Male, upper; female, lower

HOUSE FINCH (Carpodacus mexicanus frontalis).

Length, about 6 inches. Grayish brown above, many feathers tinged with red. Below dull white, crown, rump, and throat crimson.

Range: Resident in Oregon, Idaho and southeastern Wyoming south to Lower California and Mexico.

The pretty little house finch of the far west is among the most domestic of American birds, and exhibits a predilection for the neighborhood of houses almost as strong as that of the English sparrow. It carols its sprightly lay from the tops of buildings in villages and even cities, and from the shrubbery of lawn and park. So confiding has the bird become that it places its nest in any crack or cranny of house or outbuilding that is large enough for its housekeeping operations. When such convenient and safe retreats are not to be had it builds a bulky nest in a tree or bush.

It is fond of fruit, including pears, cherries, and small fruit, which its strong conical bill enables it to break open with ease. Locally, therefore, it is a good deal of a pest and does much damage to fruit crops, especially where it is numerous. Much, however, can be said in mitigation of its offenses. The seeds of plants, a large proportion of those of noxious weeds, constitute seven-eighths of its food for the year. Plant lice which are notoriously harmful to many trees and plants, also are a favorite diet. So too are caterpillars and beetles; therefore, the balance is decidedly in the bird's favor.

This attractive songster was carried to the Hawaiian Islands years ago and now is numerous in Honolulu and also in the forest on the island of Hawaii where amid brighter and more tropical neighbors it seems curiously out of place, though it sings as often and as joyously as it ever did in its old haunts across the Pacific.

ARKANSAS GOLDFINCH (Astragalinus psaltria and sub-species).

Length, about $4\frac{1}{2}$ inches. Upper parts olive green, more or less mixed with black in the sub-species; under parts yellow.

Range: Breeds from southern Oregon, Utah and northern Colorado to southern Lower California and into Mexico.

In the far west this goldfinch takes the place of the eastern goldfinch which in a general way it much resembles in habits. Like that bird it is rarely seen, save in the breeding season, except in small parties, the members of which seem to be on terms of the utmost familiarity and accord. The flight of this species, as of its kindred, is exceedingly characteristic. It disdains to cleave the air in straight lines but progresses in a series of graceful sinuous curves, which, however, take the little aeronaut rapidly from point to point. This flight is a sure mark of identification. The bird has a sweet warbling song and even its call notes are plaintive and pleasing. It abounds in orchards and gardens and is often to be seen by the roadside gleaning its food from the tall stems of thistle, sunflowers, groundsel and other seed-bearing plants and weeds, all of them either useless or positively harmful. It is by no means wholly a vegetarian, however, and eats many plant lice, sometimes filling the stomach with these minute creatures to the exclusion of all other food. As a weevil eater it is peerless, and it does no harm to any product of husbandry. Altogether this pretty little goldfinch deserves protection at the hands of men

PURPLE FINCH (Carpodacus purpureus).

Length, about 6 to 6½ inches. Unlike any other eastern finch, the crimson head of the male sufficiently distinguishes it.

Range: Breeds in southern Canada and southward to North Dakota, Minnesota, Illinois, Pennsylvania mountains, and northern New Jersey; winters from somewhat north of the southern boundary of its breeding range to the Gulf States.

Considering that it is common and widely distributed, the purple finch is not so well known as it should be. For one thing it has a marked liking for the tops of trees, particularly elms, and when in a tree top and more or less screened by foliage it requires the aid of a good glass to make its identity sure. Its warbling song is sweet and melodious but is all too brief for perfect enjoyment, though in spring the bird is prodigal enough of its carols, and not infrequently a dozen males may be heard singing at once in the same or in contiguous trees. It frequently nests around houses and for a site is very partial to the Virginia Juniper.

The purple finch lives almost entirely on the seeds of various plants, including those of false buckwheat and ragweed, with some wild berries. It is accused, not without reason, of being a confirmed budder of fruit and other trees, but the damage it inflicts on eastern orchards appears to be very slight, if indeed the modest budding it does is an injury at all.

AMERICAN GOLDFINCH (Astragalinus tristis and sub-species).

Length, about 5 inches. Easily distinguished by its rich yellow plumage and black crown and tail.

Range: Breeds from southern Canada south to southern California, southern Colorado, Arkansas and northern Georgia.

The thistle bird is one of our best known finches, being not only common but very sociable. It usually goes in small flocks, or family parties, and sometimes the tall thistles on which it likes to feed bend with the united weight of several of the gay plumaged little goldfinches. It is a law unto itself as regards its nesting period, and begins to think seriously about housekeeping when other birds are feeding full grown youngsters, or are debating the propriety of a second brood. The goldfinch has a pretty and plaintive call note, and its full song is well worth listening to. It is much like that of the canary, so much alike, in fact, that the bird is often called the wild canary.

Throughout the year the goldfinch is a seed eater, especially of weed seeds, and it eats also many insects, including canker worms, plant lice, and beetles. Our goldfinch sometimes annoys the farmer by attacking the lettuce seeds which have been left to mature for next season's planting, but the damage in this way is slight, and Prof. Beal has been told that even on the large seed farms of California it is never serious enough to call for protective measures.

(See Biol. Surv. Bul. 17 and Bul. 34, pp. 71-73.)



VESPER SPARROW
BLUE GROSBEAK
Male, upper; female, lower

Cardinal Male, upper; female, lower California Quail

VESPER SPARROW (Poocetes gramineus and sub-species).

Length, about 6 inches. Its white tipped outer tail feathers distinguish this individual from its brown liveried fellows.

Range: Breeds from southern Canada south to Oregon, Arizona, Texas, Kentucky, Virginia and North Carolina; winters from southern California, Texas, Missouri and North Carolina, south to the Gulf coast and southern Mexico.

There is little about this brown streaked sparrow to attract attention and, until it flies and displays the white tipped tail feathers, you might mistake the bird for any one of a half dozen of the sparrow family. Indeed if one catches merely a glimpse of a vesper sparrow crouched low and running swiftly through the grass one may be forgiven for mistaking the bird for a mouse. It frequents open pastures and when singing likes to mount a rocky boulder so common in New England and other parts of the east. We are perhaps justified in calling its song its most notable characteristic. Though not a pretentious effort the voice of the vesper sparrow is sweet and plaintive beyond expression, and harmonizes with the dying day as does the song of no other bird.

Prof. Beal records the fact that in winter the food of this sparrow consists wholly of vegetable matter, while in summer it consists of little else than insects. The vesper sparrow cares less for grass seed than any other of its fellows but consumes great quantities of weed seeds. It eats also large numbers of grass-hoppers, caterpillars and weevils. A number of these sparrows taken in Utah where the newly imported alfalfa weevil is doing much damage were found to have eaten these weevils to the average extent of more than half their food. Thus the value of this bird to the farmer cannot be questioned.

BLUE GROSBEAK (Guiraca cærulea and subspecies).

Length, about 7 inches. Distinguished by its larger size from the inaigo bird which alone resembles it.

Range: Breeds in the southern United States north to northern California, Colorado, Nebraska, southern Illinoisand Marylana and south to southern Mexico; winters in Mexico and Central America.

One seldom sees the blue grosbeak at short range or under circumstances which make identification easy, as the bird is rather shy and frequents brushy thickets and viny tangles much as does the indigo bird. The low warbling song of this grosbeak may be compared with that of the purple finch but it is neither so loud nor so well sustained. Under the name of "blue pap" the grosbeak used to be a favorite cage bird in Louisiana and other southern states, and no doubt is so today, despite protective laws. In the matter of diet it shows a marked preference for insect food over vegetable, the proportion being about 67 to 33 per cent. The vegetable matter includes many weed seeds, as foxtail and bindweed, also corn, the taking of which makes a black mark against its record. As, however, the bird consumes twice as much animal matter as vegetable, the balance is much in its favor and it accordingly earns protection as well by its economic service as by its beauty and song.

CARDINAL (Cardinalis cardinalis and sub-species).

Length, about 84 inches. Its size, crest and bright red color serve for instant identification.

Range: Southern United States generally, west to Texas and southern Arizona, north to lower Hudson, northern Ohio, northern Indiana, southern Iowa and southeastern South Dakota; resident.

The cardinal is a notable bird and any locality he chooses for his residence must be considered highly favored. His bright colors, trim form and erectile crest, his clear whistling call, and his fine song are all to his credit. He is a resident of thickets and tangled undergrowth with hanging vines, and, when these are provided and he feels safe from the prowling cat and marauding hawk, he will take up his abode in your garden or back yard as readily as anywhere else. Favor him further by supplying him food and water in winter and you make him your friend indeed. Practically he is a resident wherever found and the sight of his flashing red suit amidst snow covered bushes is a memorable picture. cardinal used to be a favorite cage bird in the Southern States and the business of trapping him for market, especially about the large southern cities, was common. The bird is now protected by law as it should be, and the sight of a cardinal behind prison bars has become rare indeed. How many thousands were sacrificed for hat gear we shall never know but happily this practice too is fast disappear-

By preference the cardinal is a vegetarian, and about seven-tenths of its food consists of vegetable matter in the form of seeds, berries, etc. But it also eats many insects, potato beetles, cotton worms, boll worms, cotton-boll weevils, codling moths and many other searcely less note worthy. Mr. McAtee in attempting to sum up all the economic facts, declares that the bird does at least fifteen times as much good as harm, which is a record to be proud of.

CALIFORNIA QUAIL (Lophortyx californica and varieties).

Length, about $9\frac{1}{2}$ inches. Distinguished from Gambels' quail by the reddish instead of black belly. Range: Resident in the Pacific Coast region from southwestern Oregon and western Nevada through California and Lower California.

The California quail is one of our most beautiful game birds and the sight of a large covey running daintily along, with crests nodding and fine plumage gleaming in the sun is a sight to remember. Before quail were so much persecuted, covies were common in the gardens of Oakland and other California towns, seemingly as much at home among calla lilies and rosebushes as in the stubble field. The numerous families in the fall associate in bands of three or four hundred, or even more. The California quail has learned one lesson never acquired by our bob-white—to roost in trees and bushes instead of on the ground, and no doubt the safety thus obtained during the hours of darkness is one reason for its great abundance.

This quail is the greatest vegetarian of any of our game birds, the vegetable food eaten by over 600 individuals examined amounting to 95 per cent of the total food consumed. Unfortunately the California quail consumes much grain when germinating and thus damages the growing crop; it also attacks grapes and, while it does not eat a great many, it seriously damages bunches by puncturing a few grapes here and there, so ruining the fruit for market.



TREE SWALLOW
SCARLET TANAGER
Male, upper; female, lower

CLIFF OR EAVES SWALLOW
WESTERN TANAGER
Male, upper; female, lower

TREE SWALLOW (Iridoprocne bicolor).

Length, about 6 inches. The steel blue upper parts and pure white under parts are distinguishing characteristics.

Range: Breeds from northwestern Alaska and northern Canada south to southern California, Colorado, Kansas, Missouri, and Virginia; winters in central California, southern Texas and Gulf States and south to Guatemala.

In its primitive state the tree swallow used to nest in hollow trees, and in some parts of the country it still continues to do so. Early in the settlement of the country it saw the advantage of putting itself under man's protection, and now no bird is quicker to respond to an invitation to nest in a box dedicated to its use. The bird lover within the range of the species may secure an interesting tenant or two by the expenditure of a little trouble and labor, since the bird is not a bit fastidious as to its domicile, providing it is weather tight. Tree swallows arrive from the south early in April and soon begin to nest. In the fall they gather in great flocks preparatory to their departure, and may then be seen by hundreds perched on telegraph wires. As is the habit with swallows generally, tree swallows migrate by day feeding as they go, and a flock passing swiftly south presents to the casual observer an every day appearance well calculated to deceive. Watch the flock as it crosses the road and passes from field to field and you will notice that while the line of flight has many a twist and turn it trends steadily to the south and that no individual takes the back track.

The tree swallow consumes vast numbers of gnats, flying ants, beetles, mosquitoes and other flying insects. It exhibits a rather curious departure from the traditions of its kind in that it appears to be very fond of the berries of the bayberry or wax myrtle. It also often chooses these bushes for a roosting place at night.

SCARLET TANAGER (Piranga erythromelas).

Length, about 7¹ inches. The scarlet coat and black wings and tail mark this bird out from all others.

Range: Breeds from southern Canada south to southern Kansas, northern Arkansas, Tennessee, northern Georgia and mountains of Virginia and South Carolina; winters from Colombia to Bolivia and Peru.

The tanagers are strictly an American family, and as their bright colors might seem to suggest, they originated in the Tropies to which most of the numerous species are confined. In fact the gleam of searlet from the coat of this tanager in our somber woods always seems a little out of place as though the bird were an alien. But it is wholly at home with us, and, indeed, does not hesitate to make its summer residence still farther north in Canada. Curiously enough the nearest relatives of the brilliant tanagers in the bird world are the plainly colored sparrows. The chirp-churr of the tanager is a familiar call note in our northern woods, while its song is one of the sweetest; so that altogether this species is to be classed as a notable member of our bird world.

In some localities it is accused of eating honey bees, but to offset this local habit it devours the potato-beetle and many other beetles and a great variety of caterpillars. Blueberries and other small berries also form an important part of its food.

CLIFF SWALLOW (Petrochelidon lunifrons and sub-species).

Length, about 6 inches. The rufous upper tail coverts serve to distinguish this swallow from other species.

Range: Breeds from central Alaska and northern Canada south over the United States (except Florida) and to Guatemala; winters in South America.

The cliff and the barn swallow are members in good standing of the original guild of masons, and their clever constructive work in nest building with mud pellets will bear the severest professional inspection. Through much of the west the cliff swallow still attaches its mud house to the faces of cliffs as from time immemorial, and it was not until the farmers' house and barn offered a satisfactory substitute for granite and sandstone bluffs, that the bird became really numerous in our eastern States. In some localities this swallow is not a welcome guest about the homestead as its nest is apt to contain parasites which the good housekeeper fears. Such parasites, however, are not to be dreaded as they will live only on birds. The cliff swallow performs invaluable service to man since its food consists wholly of insects, and among them are many pestiferous kinds, such as leaf-bugs, leaf-hoppers and the boll weevil. Whoever then protects this and other species of swallows and encourages their presence on their premises does good and patriotic service and can moreover be sure of adequate reward.

WESTERN TANAGER (Piranga ludoviciana).

Length, about 7 inches. The combination of orange-red head, black back, and yellow under parts are distinctive.

Range: Breeds from northeastern British Columbia, southwestern Mackenzie and southwestern South Dakota to the mountains of southern California and New Mexico; winters from central Mexico to Guatemala.

Discovered in Idaho by Lewis and Clarke in 1806, this tanager has thus been known more than a hundred years in which time it has become one of the most familiar of western birds. It is a common inhabitant of both the western Rocky Mountains and the Sierra Nevada, and is very much at home among the pine woods of which it is the brightest ornament. In general its habits are like those of its scarlet cousin, and it also has a sweet song very similar in general effect. In California this tanager has acquired an evil reputation by attacks on the cherry crop, and there is no doubt that when it assembles in large numbers in the fruit districts it is the cause of heavy loss to small fruit growers. Under ordinary circumstances, however, the greater part of its food consists of insects, many of them harmful, and it is only fair to balance the good the bird does against the harm. Two very harmful families of beetles, whose larvæ are wood borers and do much damage to trees and other plants, are represented in the food. The planting of berry bearing trees near the orchard would no doubt prevent much of the loss, occasioned by this bird, which by no means occurs every year. For the rest the fruit grower must be allowed to protect his fruit in the best and most effective way.



YELLOW-HEADED BLACKBIRD Male, upper; female, lower STARLING

Cowbird
Male, upper; female, lower
Chimney Swift

YELLOWHEAD (Xanthocephalus xanthocephalus).

Length, about 10 inches. Our only blackbird with a yellow head.

Range: Confined to western North America. Breeds from southern British Columbia, southern Mackenzie, southwestern Keewatin, and northern Minnesota to southern California and Arizona, east to southern Wisconsin, Illinois and Indiana; winters from southwestern California, southern Arizona, southeastern Texas, and southwestern Louisiana south into Mexico.

Apparently Nature started out with the intention of making an oriole but decided to make a blackbird instead-and behold the yellowhead. He is a sociable chap and nests in great companies in the tule swamps of the west. The yellowhead's voice is harsh and guttural and his vocal efforts have been well characterized as a maximum of earnest effort with a minimum of harmony. Late in midsummer when the young are on the wing, old and young betake themselves to the uplands, grain fields, pastures and corrals, associating as often as not with redwings and Brewer's blackbirds. The yellowhead feeds principally upon insects, grain and weed seed, and does not attack fruit or garden produce; but it does much good by eating noxious insects and troublesome weeds; where too abundant it is likely to be injurious to grain.

(See Biol. Surv. Bul. No. 13, 1900, p. 32.)

STARLING (Sturnus vulgaris).

Length, about 8½ inches. General color dark purple or green with reflections; feathers above tipped with creamy buff. In flight and general appearance unlike any native species.

Range: At present most numerous near New York City. Has spread to Massachusetts, Connecticut, New Jersey, Pennsylvania, Maryland, Virginia and recently to the District of Columbia; resident where found, though wandering southward in winter in search of food.

The Old World has sent us two bird pests, the English sparrow and the starling. Although, up to the present time, we cannot convict the starling of having done any great damage he has proclivities which make him potentially very dangerous. Introduced into New York in 1890, the original sixty have multiplied many fold and spread in all directions till now they occupy territory hundreds of miles square, and are multiplying and spreading faster than ever. On the north they have entered Massachusetts and Connecticut, and on the south they have reached Richmond, though only in migration. Even as I write the calls of a flock of 200 or more can be heard coming from a neighboring park, but as yet the bird has not elected to summer in the National Capital. The starling is a hardy, prolific bird and is also aggressive. Like the English sparrow it associates in flocks, which is a great advantage in bird disputes. There is little doubt that the effect of its increase and spread over our country will prove disastrous to native species such as the bluebirds, crested flycatchers, swallows, wrens and flickers, all valuable economic species, which nest in cavities as does the starling. Then too the starling has a taste for grain and small fruits, especially cherries, which will not commend it to our farmers and orchardists.

COWBIRD (Molothrus ater).

Length, about 8 inches. Male glossy black, head, neck and breast brown. Female brownish gray.

Range: Breeds from southern British Columbia, southern Mackenzie and southeastern Canada south to northern California, Nevada, northern New Mexico, Texas, Louisiana and North Carolina; winters from southeastern California and the Ohio and Potomac Valleys to the Gulf and to central Mexico.

Chapman calls the cowbird a villain-but is not the villain in the piece often the most interesting character on the stage? Thus our cowoird, short as he is of manners and morals, cannot fail to interest the bird lover. He is full of idiosyncrasies that keep one guessing. Why for instance his close association with the peaceful cow? Why his ludicrous attempts to sing, he who has not a thread of music in his whole make-up? How did Madame Cowbird come to lapse from the paths of virtue and, in place of building a nest of her own, foist her eggs and the care of her offspring on smaller and better principled birds to their detriment? Leaving these conundrums for wiser heads to solve, I must say that the cowbird seems to have chosen the smooth path to prosperity. It makes an easy livelihood, having no parental cares or worries, and is common and widely distributed. The farmer seems to have little to complain of in respect to the bird's food habits.

(See Biol. Surv. Bul. 13, p. 29, 1900.)

CHIMNEY SWIFT (Chætura pelagica).

Length, rather less than $5\frac{1}{2}$ inches. Too well known by its peculiar flight and habits to need describing.

Range: Known only in eastern North America. Breeds from southeastern Saskutchewan, Manitoba, Quebec, and Newfoundland south to Gulf Coast; west to Plains from eastern Montana to eastern Texas; winters south of the United States.

The popular name of this bird, chimney swallow, embodies an error since the bird not only is not a swallow but is not even distantly related to the swallow family. Unlike the humming birds as the chimney swift is in appearance and habits, it is structurally not far removed from them. Like the swallows it is an indefatigable skimmer of the air and like them it earns a debt of gratitude by destroying vast numbers of our winged enemies, which its unsurpassed powers of flight enable it to capture. Indeed, chimney swifts eat nothing but insects, and no insect that flies is safe from them, unless it be too large for them to swallow. In June swifts may be seen gathering twigs for nest material. They disdain to pick these up from the ground but seize the coveted twig with their strong feet and break it off from the terminal branch when in full flight. By means of a sticky saliva secreted for the purpose the swift glues these twigs to the sides of the chimney in the form of a shallow nest. Although not generally known, swifts roost in chimneys and cling to the walls by using the sharp pointed tail as a prop, as do many woodpeckers in ascending trees. Any bird lover may secure distinction by solving an ornithological riddle and telling us where our chimney swifts spend the winter. They come in spring, they go in fall and at present that is about all we know of the matter, save that they do not hibernate in hollow trees, as many have believed.



BLACK-CROWNED NIGHT HERON
. Male, upper; young bird, lower
HERBING GULL
Adult in winter, upper
Adult in summer, lower

GREAT BLUE HERON COMMON TERN

BLACK-CROWNED NIGHT HERON (Nycticorax nævius nævius).

Length, about 24 inches. The black crown distinguishes it from its relative, the yellow-crowned night heron.

Range: Breeds from northern Oregon, southern Wyoming, southern Manitoba, and central Quebec south to Patagonia; winters from northern California and Gulf States southward.

Given for a roosting place a suitable stand of leafy trees, especially evergreens, conveniently near a stream or pond that harbors fish, frogs and tadpoles, and any locality may have its colony of night herons. As its name implies, this heron is a bird of the night, not leaving its roost till dusk when, with frequent iteration of its hoarse quawk, it wings its way in the gathering gloom straight to its feeding place. So rarely is the bird about in daylight that a large colony may exist for years near a town or large city, and not above a dozen individuals have an inkling of its existence. True to its sociable instincts, the night heron by preference nests in colonies, and several pairs often place their rude nests of sticks in the same tree; or, in the absence of trees, as in the extensive tule swamps of the far west, where other conditions are ideal for herons, they nest on the ground or on the prostrate tules, hundreds of pairs being associated together.

This heron sometimes feeds on field mice, but it eats too many fish to please the fishculturist, and after it has once learned the way to a hatchery strong measures are needed to discourage its activities.

HERRING GULL (Larus argentatus).

Length, about 24 inches. Deep pearl gray above; much of rest of plumage white. Not readily distinguished in life from its allies.

Range: Breeds in Alaska and in Arctic regions south to southern British Columbia, southern Alberta, northern North Dakota, central Wisconsin southern Ontario, northern New York, and Maine; winters from southern British Columbia to Lower California and western Mexico, and from Gulf of St. Lawrence and Great Lakes south to Bahamas, Yucatan, and coast of Texas.

All things considered, the herring gull is probably the best known of the family by reason of its abundance and wide distribution. Moreover, this is the gull most frequently noticed by passengers as it follows in the wake of our ocean and trans-Atlantic steamers. It breeds no farther south than the coast of Maine, but in winter it is very numerous along the Atlantic coast and in many of our inland ponds. It does excellent service as a scavenger in our harbors, venturing fearlessly among the shipping to secure anything edible that may find its way overboard. The services of this and other gulls in such a capacity are so valuable that their destruction under any pretense is to be deprecated. When the craze for feathered hat gear was at its height thousands of gulls, without regard to species, were killed for millinery purposes, but it is to be hoped that, now the sale of their feathers is illegal practically everywhere in the United States, the gulls will rapidly increase.

(See Biol. Surv. Bul. 17, pp. 53, 80.)

GREAT BLUE HERON (Ardea herodias and sub-species).

Length, from 42 to 50 inches.

Range: Breeds from the southern Canadian provinces south to southern Lower California, southern Mexico and South Atlantic States; winters from Oregon, the Ohio Valley and Middle States south to the West Indies, Panama and Venezuela.

When one sees a large bluish bird, with long neck and stilt-like legs, standing motionless by river, pond or lake, or slowly wading in the shallows, he may be sure he has before him the great blue heron, and a notable bird he is in many ways. Wary as this heron is and keen to scent danger, he offers so tempting a mark as he wings his way slowly along, with head and neck drawn in against the body and long legs trailing behind, or as he stands motionless watching for game, that he is frequently shot "just for the fun of it." This wanton taking of life is never justifiable, but when the life cut short represents so much beauty and grace as are embodied in this. stately bird, the crime seems doubly heinous. Naturally this heron is much less common than he used to be.

Small fish, frogs, tadpoles, and snakes form the bulk of his food, and in some regions he is a determined foe of mice and gophers, and the sight of a heron in the midst of a dry pasture or in a stubble field watching for a gopher to emerge from his hole is very common.

(See Biol. Surv. Bul. 31, p. 52; also Bul. 17, p. 217.)

COMMON TERN (Sterna hirundo).

Length, about 15 inches. The pearl-gray breast and belly distinguish the adult of this tern from its relatives. The outer web of the outer tail feathers is darker than the inner web; the reverse is true of Forster's Tern, its nearest ally.

Range: Breeds from Great Slave Lake, central Keewatin and southern Quebec south to southwestern Saskatchewan, northern North Dakota, southern Wisconsin, northern Ohio and North Carolina; winters from Florida to Brazil.

Our common tern is, alas, common no longer. The Atlantic coast is peculiarly fitted to be the home of the terns by reason of the extensive shallows and the great number of sandy islands on which terns and gulls used to breed in absolute safety. At the bidding of fashion, however, thousands of these beautiful creatures were slaughtered till the sand was red with their blood and island colonies that used to number thousands were exterminated. No excuse serves to palliate the crime of the wholesale murder of these graceful sea swallows, as they are aptly termed, which used to make our shores so attractive by their presence. But the tide seems to have turned, partly at least. The Government has set aside islands as breeding resorts and places of refuge and, through the activity of Audubon Societies and of individual workers, a certain measure of safety seems now assured to these persecuted birds. It may even prove possible, by the bird sanctuary plan, to increase their numbers again and make them a familiar sight along our deserted shores. Could the sentiment of the women of the United States be united for their protection, all doubt as to the future of these beautiful creatures would be removed, but so long as the arbiter of Fashion decrees feathers on hats, so long will the eternal vigilance of their friends be needed to assure the safety of the small remnant of this species and its kindred.



GREAT HORNED OWL COOT

Wood Duck Male, upper; female, lower Spotted Sandpiper

GREAT HORNED OWL (Bubo virginianus and sub-species).

Length, about 22 inches. The great size and long ear tufts sufficiently distinguish this owl.

Range: Resident even the greater root of North

Range: Resident over the greater part of North and South America.

This, our largest owl, inhabits heavily forested and unsettled regions and is becoming more and more rare in thickly populated areas. It is well known by its far reaching call—"hoo-hoo-hoo-hoo"—which is heard best in the still small hours of the night, when it echoes across the expanse of canyon and forest in the far west.

This owl destroys many partridges and other game birds, and unhoused poultry is never safe from its nocturnal attacks. Its deeds are those of darkness, since usually it hunts only at night, though when disturbed in the daytime it can see well enough to take good care of itself. Its bill of fare is a long one and includes many kinds of mammals and birds. It is one of the few creatures which when hungry do not hesitate to attack the skunk, and it appears to have no great difficulty in killing this rather formidable little beast. That it does not always do so with entire impunity is evident from the odor frequently attaching to its feathers. Its destruction of rodents entitles it to our gratitude, especially when it kills pocket gophers, rats, mice, ground squirrels and rabbits. In some parts of the west rabbits are responsible for much damage to orchards and crops and consequently their reduction is a blessing. Nevertheless the protection of this big and ficrce owl cannot be recommended on sound economic grounds.

COOT (Fulica americana).

Length, about 15 inches. The slate-colored plumage, with blackish head and neck, white bill, and scalloped toes mark this bird apart from all others.

Range: Breeds from southern Canada south to Lower California, Texas, Tennessee and New Jersey; also in southern Mexico and Guatemala; winters from southern British Columbia, Nevada, Utah, Ohio Valley and Virginia south to Panama.

The coot, or mud-hen, is a sort of combination of duck, gallinule and rail, and withal is a very interesting bird. Fortunately for the coot, its flesh is little esteemed, and by many, indeed, is considered unfit for human consumption. The coot is thus passed by in contempt by most sportsmen, and in some regions it is as tame as can well be imagined, swimming within a few feet of the observer with entire unconcern. Under other circumstances, however, as in Louisiana, where it is shot for food under the name poule d'eau, it becomes as wild as the most wary of ducks. It frequents both salt and fresh water, preferably the latter. The mud-hen is one of the few American birds that occasionally visits the distant Hawaiian Islands in fall and winter. Finding conditions there to their liking, some of the immigrants, probably centuries ago, elected to remain and found a new colony, and there, in the fresh water ponds of the island archipelago, their descendants still live and thrive.

The food of the coot consists almost entirely of water plants of no use to man. There would seem, therefore, to be no excuse for killing or disturbing the bird in any way.

WOOD DUCK (Aix sponsa).

Length, about 19 inches. The elongated crest of feathers and variegated plumage of white and brown, spotted with chestnut, ochraceous and steel blue are characteristic.

Range: Breeds from Washington to middle California, and from Manitoba and southeastern Canada to Texas and Florida; winters chiefly in the United States.

It can be said of this duck, as of no other, that it is our very own, since most of the breeding area it occupies is within our territory, and by far the greater number of the species winter within the United States. The story of its former abundance on our ponds and streams and of its present scarcity is a sad commentary on our improvidence and a warning for the future. Happily, it is not yet too late to save this most beautiful of our ducks, and under proper regulations it may be expected not only to hold its own, but to increase until it is once more a proper object for the skill of sportsmen. Under present conditions all true sportsmen should refrain from its further pursuit.

As is well known, the wood duck is one of the few wildfowl that builds its nest in hollow trees, and the security thus provided for the young is one of the factors to be relied upon for the increase of the species. North, south, east and west, the States of every section are, or should be, interested in the preservation of this distinctively American duck, and should make suitable regulations for its welfare and see to their enforcement.

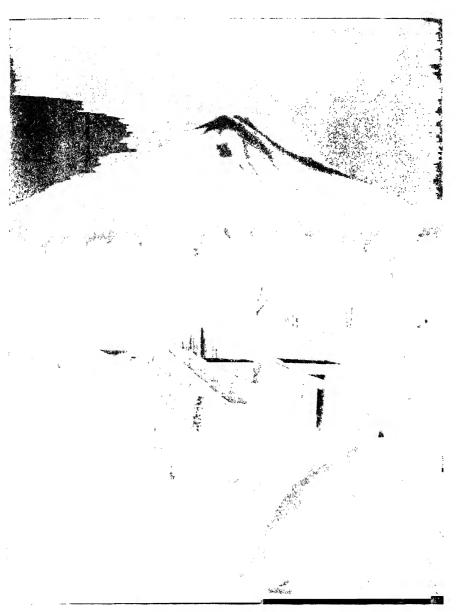
SPOTTED SANDPIPER (Actitis macularia).

Length, about 6 inches. The "tip up," with its brownish gray upper parts and white under parts and its teetering motion, is too well known to need description.

Range: Breeds in northwestern Alaska and in much of northern Canada south to southern California, Arizona, southern Texas, southern Louisiana and northern South Carolina; winters from California, Louisiana and South Carolina to southern Brazil and Peru.

ern Brazil and Peru.

The little "tip up," as it is appropriately named, from its quaint nodding motion, unduly favors no one section or community but elects to dwell in every region suited to its needs from Alaska to Florida. It is doubtless more widely known than any other of our shore birds, and as it takes wing when disturbed, its "wit, wit" comes to us from beach, river side, and mill pond, from one end of the land to the other. It is the only shore bird that habitually nests in cornfields and pastures, and its handsome buff eggs spotted with chocolate are well known to the farmer's boy everywhere. Much is to be said in favor of the food habits of the little tip up, as the bird includes in its diet army worms, squash bugs, cabbage worms, grasshoppers, green flies and crayfishes. Having thus earned a right to be numbered among the farmers' friends, the bird should be exempt from persecution. The tiny morsel of flesh afforded by its plump little body, when the bird has been shot, is in no sense an adequate return for its services when alive and active in our behalf.



THE SNOW-CROWNED MT. ORIZABA

Photo by Frank M. Chapman

"The country lying between the cities of Vera Cruz and Mexico City possesses more varied natural attractions than any other area of similar extent in the world" (see text, page 533). "The summit of Orizaba can be reached without great difficulty. One may travel to an altitude of 15,000 feet by mule, and the remaining 3,000 odd feet are traversed on foot. No physical obstacles are encountered, and the walk to the top is merely a matter of legs, lungs, and heart" (see text, page 548).

A NATURALIST'S JOURNEY AROUND VERA CRUZ AND TAMPICO

By Frank M. Chapman

CURATOR OF ORNITHOLOGY IN THE AMERICAN MUSEUM OF NATURAL HISTORY

With Photographs by the Author

HILE fully aware of the high percentage of error most sweeping assertions contain, I nevertheless venture to claim that the country lying between the cities of Vera Cruz and Mexico City possesses more varied natural attractions than any other area of similar extent in the world.

From the moment when, on the Gulf, one sights the still distant Sierra, until one reaches the site of Tenochtitlan itself, one's attention is held by a variety of interests which make the trip from coast to table-land, and the snow-peaks rising from it, an epitome of a journey from

equatorial to boreal regions.

If one is in search of supremely beautiful scenery, it is here to and beyond the limit of human appreciation. would test the climates of the world, he may go in a day from perpetual summer to everlasting snow, and at the same time pass from belts where rain falls almost daily to others where it is rarely known. With these extremes of temperature and humidity there is, of course, a corresponding diversity in flora and fauna, which makes the region of exceptional interest to the botanist and zoölogist, and particularly, as I shall endeavor shortly to show, to the student of the distribution of life.

For the archeologist there are ruins which evince a high degree of aboriginal culture; and for the ethnologist, natives who, in retaining their tribal customs, offer problems of fundamental importance in connecting the present with the past.

The historic period opens with the incomparable romance of Cortez and Montezuma, of Aztecan and Tlaxcalan, and passes through three centuries of Spanish government, the war of independence, the

short-lived empire of Maximilian, and the campaign of Scott, to the astonishing era of material development under Diaz, and the no less disastrous years of disintegration once his iron grip was loosened.

Thus, omitting all reference to natural resources and commercial possibilities, whether one be a student of nature or of man, or merely a tourist in search of the novel and beautiful, this portion of Mexico will appeal to him with a force and fascination which makes a journey through it one of the memorable experiences in a lifetime of travel.

ENTER FROM THE GULF

Be one student or tourist, there can be no question that one should enter Mexico from the Gulf. Were it not for customshouse formalities, the northern boundary might be crossed unawares at many points; but to follow for days in the wake of the Conquistadores produces a mental condition which prepares one properly to enjoy a definite arrival in Mexico near the landfall of Cortez. A journey from the coast to the capital follows a natural succession of climatic zones as well as the sequence of early historic events.

Furthermore, steamers so arrange their schedules that they reach Vera Cruz in the morning, and we begin our day, therefore, alert and eager for the experiences incident to travel in a land where the eye is greeted by strange sights, the ear by

unfamiliar sounds.

The day, indeed, should begin at sunrise, some hours before disembarking at Vera Cruz, with a hope that one may have the rare good fortune to see the first rays of the sun touch the summit of Mt. Orizaba, the first, as it will be among the most lasting, of one's impressions of

Mexico. The shore is still some 30 miles distant, the mountain itself about 100 miles, and one is with difficulty convinced that the gleaming pink cloud high above the horizon is part of the still invisible earth beneath it. Doubtless the Aztecs were not familiar with this view of Mt. Orizaba, but from no other place is their name for it—Citlaltapetl, the Star Mountain—so applicable.

On only one of three voyages to Mexico have I had this thrilling view of Orizaba's snow-crown, but in default of it there is still the sunrise over the Gulf, and if this be obscured, there is always the Gulf itself, usually calm at this hour, and the half-speed at which the steamer is moving to prevent too early an arrival at Vera Cruz, gives one an exceptional opportunity to see the surface life from her deck.

SCHOOLS OF FLYING FISH

Nearly every little raft of gulf-weed shelters a swarm of small fish; near the Arcos keys the black and white gannets, which evidently live there, are abundant, and occasional herring gulls, sooty or bridled terns, and frigate birds are seen, while at frequent intervals flying fish, flushed by the steamer, spring from beneath the bow and scale away. One exceptionally calm morning, when the Gulf was glassy smooth, we could see them from the bow of our ship, swimming ahead a foot or two beneath the surface.

As the steamer bore down on them they darted right and left, or at our too close approach took to the air. For 20 to 40 feet they touched the surface when the tail and long, wing-like pectoral fins were in rapid motion, the latter being moved up and down. The body was held at an angle and apparently only the lower lobe of the tail touched the water, making, when it struck, a series of connected Sufficient headway being thus gained, the fins became rigid and the creature scaled or sailed, a true aëroplane, until momentum was lost, when it plunged abruptly into the water. When the tail struck the crest of a swell the "wings" also vibrated, and fresh force was thus acquired, but the calmness of the sea afforded few opportunities for this method

of prolonging the sail. This varied from a few feet to 150 yards, with frequent changes of direction.

March 4, 1910, as the steamer passed the island fortress of San Juan de Ulloa and glided inside the breakwater to the substantial customs pier, our preparations for immediate landing were halted by the tardiness of the health officer, who, after keeping us impatiently waiting for an hour, conducted his inspection with exasperating deliberation; nor were we declared free until the last steerage passenger had been examined.

CONQUERING PEACEFUL BANDITS

In the meantime, on the pier below, a horde of *cargadors* had gathered behind the rope before which the baggage had been piled. As we descended the gangway the rope was dropped, and we were charged by a mob of shouting, gesticulating porters, five or six of whom shoved their badges into one's face at the same moment, grabbed our hand baggage, and all but tore us into fragments. It was a scene of riotous confusion, with two or three score bandits pulling, shoving, swearing, dodging, fighting for the privilege of taking our luggage to hotel or railway station, and I emerged from the fray with all our 14 trunks, 14 valises, and the exultation of a conqueror.

Time was when Vera Cruz was dreaded as a pest-hole, and trains at once took one from the steamer up the Sierra on the way to Mexico City, usually as far as Orizaba. Now, however, sanitary conditions and hotel accommodations have been so improved that one may stay here without danger or discomfort. At least, one should remain over night to begin the trip toward the table-land early in the morning, and thus be able to see every foot of this remarkable journey.

Fellow-travelers with whom we had shared a common interest in the events of the voyage now separated, each to his appointed task or tour. A newly appointed ambassador went to his post at the capital with small realization that out of the apparently peaceful present would soon arise a period of devastation ruinous to the interests of the country and presenting critical situations for diplomatic



 $$\operatorname{Photo}$ by Frank M. Chapman Λ VIEW OF MT. ORIZABA FROM THE TRAIL, ΛT 9,500 FEET

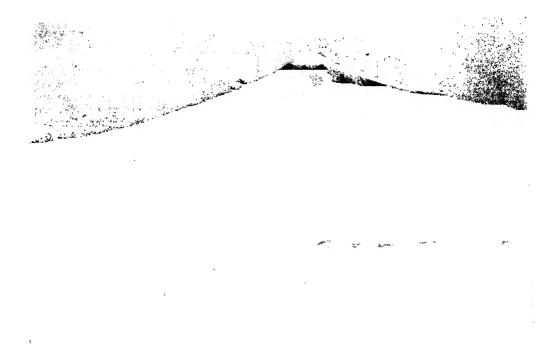
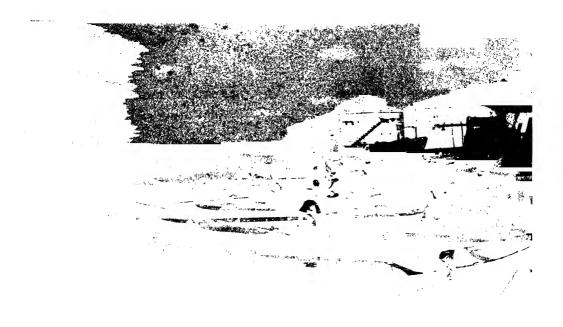


Photo by Frank M. Chapman

MULES LOADED WITH COFFEE: MT. ORIZABA IN THE DISTANCE



RIVER FRONT OF TAMPICO, MEXICO

Photo by Frank M. Chapman

treatment; a rubber planter went south to the Isthmus, an oil-man north to the petroleum deposits near Tuxpam, and an archeologist left for the ruins on the table-land.

Some came to buy, others to sell, and in more settled lands we might have had small interest in them or their calling, but your commercial man in the tropics is often an adventurer at heart and an explorer in practice, and if his reports to his "house" never reach the pages of a geographic magazine, we may admit that they not infrequently contain more novel information than many reports that do. Gratefully do I acknowledge my debt to these Knights of Trade, whose intimate knowledge of little-known trails and places has been of no small value in solving problems of transportation and subsistence.

WE PASS THROUGH TROPICAL, TEMPERATE, AND BOREAL ZONES IN 75 MILES

My own mission in Mexico was to make field studies and collect specimensand accessories for an American Museum Habitat Group, designed to illustrate the effect of altitude on the distribution of life; and the fact that nowhere on the American hemisphere can this be done so effectively as in the country lying between sea-level and snow-line on Mt. Orizaba, is in direct support of the claims made for the diverse interests of this truly wonderful region.

Reference to a map of the natural life areas of North America shows the tropic region stretching up two narrow arms on the Gulf and Pacific coasts of Mexico which, in places on the higher Sierras, are paralleled by southern extensions of the Canadian Zone of the north. Between the two lie bands of the Temperate Zone.

Thus, in our journey from the Gulf to the summit of the Sierra, we pass through Tropical, Temperate, and Boreal zones-the Tierras Caliente, Templada, and Fria, of the native. Our actual journey, in passing from sea-level to snowline, may be a matter of 75 miles, our change of altitude approximately three miles; but if we were to seek the Canadian Zone not on mountain top but on the coast, it would be necessary for us to travel to Maine or Nova Scotia. In other words, a journey of some 1,500 miles would be required to reach conditions which are here distant but three altitudinal miles.

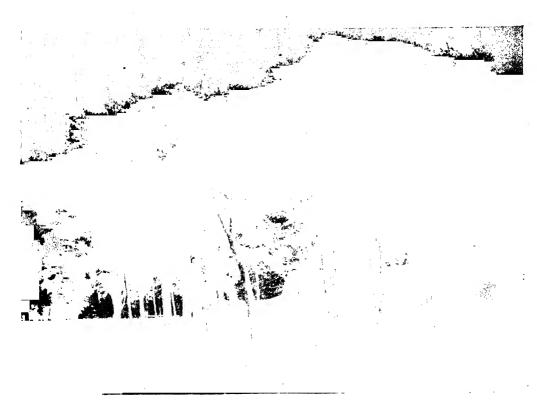


Photo by Frank M. Chapman A "FIG" TREE ON THE TAMESI RIVER, MEXICO

FROM PARROTS TO CROSSBILLS

It follows, then, that one can actually stand in a tropical jungle, where parrots, trogons, toucans, and other equatorial birds are calling from the liana-draped trees, and look upward to forests of pines and spruce, where crossbills, juncos, pine siskins, and evening grosbeaks are among the common permanently resident species.

Later, we may ascend to the snows on Orizaba to discover at approximately what altitude the palms of the Tierra Caliente give way to the oaks of the Tierra Templada, to be in turn replaced by the spruces of the Tierra Fria. As a preliminary to this journey let us first see something of the Tropical Zone.*

Circumstances led me to make studies in this zone near Tampico, and from this town of many dugouts we embarked at 6.15 on an April morning, bound for

*As a matter of fact, on this particular trip, the tropics were visited last, but the narrative follows the more natural order. Paso del Haba, a small sugar plantation on the banks of the Tamesi River distant 75 miles by water, 35 by land. In addition to our host, who proved a host indeed, our party consisted of George Shiras, 3d, Louis Agassiz Fuertes, Chapman Grant, and the writer—a company with sufficiently diverse aims to insure a many-pointed contact with nature.

Sacrificing the picturesque to the practical, we embarked in a launch with a four-horse-power engine, rather than a tolda-covered canoe of four-paddle power, and consequently reached our destination in twelve hours rather than in thirty-six. But what we gained in speed we lost in opportunity for observation.

ENCROACHING CIVILIZATION

An intrusively vulgar, tuff-tuffing motor-boat is about the most effective agent for destroying the charm and alarming the life of a quiet, remote tropical river that man has devised; but we argued that opportunities missed on the water might



Photo by Frank M. Chapman

A TREE LOADED WITH PARASITES

"In our journey from the Gulf to the summit of the Sierra we passed through Temperate, Tropical, and Boreal zones. . . . To reach conditions which are here distant but three altitudinal miles we should have to make a journey of some 1,500 miles" (see text, page 536).

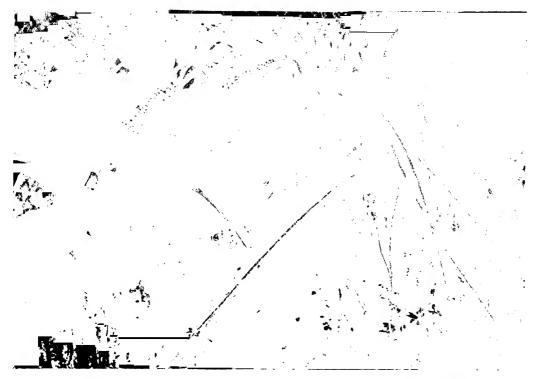


Photo by Frank M. Chapman

PARASITE VEGETATION ON LIMB OF A TREE

be found on the shore. Furthermore, on the lagoons which mark the entrance of the Tamesi into Panuco, the birds seemed to have become in a measure accustomed to the steady, even cough of our kind of craft, and we passed within gunshot of numerous coots, many species of ducks, and even a small flock of roseate spoonbills, a bird with which we hoped to become more familiar later.

Soon the Tamesi narrowed to 150 or 200 feet, a width it held with surprisingly little variation throughout the day. For a time it wound through a grazing country, which is overflowed in the rainy season, where cattle were numerous and trees almost wanting; then for miles we passed through plantations of bananas. This moisture-loving plant can be grown here only in the narrow strip formerly occupied by the original forest on the banks of the river. With the forest had gone most of the wild life; but man himself was here sufficiently primitive to be a part of the fauna, and his picturesque

thatched cabins and log-hewn canoes, and the passing glimpses of his way of life on land and water, afforded interesting illustrations of the manner in which he meets his environment.

About 60 miles from Tampico we first encountered primeval forest, which in this low, comparatively arid coastal zone is restricted to the river banks, and the immediate increase in the number and variety of birds seen, stimulated a somewhat flagging faith in the accuracy of statements concerning the bird life about the plantation which, be it confessed, we had received with more or less incredulity.

It was 5.30 when we arrived, with just enough daylight left to pitch our tents in the ranch-house clearing on the banks of the river. The brown stream flowed silently by some 20 feet below us, with no hint of the loss to life and property it had caused only the preceding season, when it flooded the country for miles.

It is commonly believed that to see



Photo by Frank M. Chapman

GREAT-TAILED GRACKLES. NEAR VERA CRUZ, MEXICO

tropical birds in abundance one must go at least to South America; but I have yet to find, in a somewhat extended experience, any place where certain eminently characteristic tropical species are more abundant than we found them at this camp on the Tamesi River distant less than four days from Chicago!

A BIRDLAND BABEL

We were awakened by the loud calls of flying parrots, not passing over at a great height, en route to some distant feeding-ground, as one usually sees them, but stopping, with much conversational chatter, to join scores which were breakfasting in the trees overhanging our tents.

At once we recognized the "double yellow-head" (Amazona oratrix) of the bird stores, rated by dealers as second only to the gray, red-tailed African parrot in its power of speech, and second to none as a whistler. With it was a slightly smaller, red-capped parrot (Amazona viridiginalis), which, whatever it may be in a cage, is vocal enough in nature. Parrakeets of two species, with darting, dove-like flight, shot through the clearing, uttering their sharp, rolling cry, or, entering a tree-top, disappeared with incom-

prehensible completeness until, assured of the safety of their surroundings, they began slowly to move about in search of food.

Red-billed pigeons (Columba flavirostris) nearly as large as our domestic bird, shouted their emphatic "hurrah," and the dainty little scaled doves filled in the gaps with their quaint put coo, put-a-coo; ground doves mourned gently, if inconsolably, and the pygny (Glaucidium) whistled with clock-like regularity from the top of a leafless tree—a perch which this diurnal, light-loving midget prefers.

Great-tailed grackles creaked, sniffled, whistled, choked, and rattled; queer little Mexican crows, looking not much larger than blackbirds, perched in flocks in the leafless trees, snoring and grunting; flycatchers (Myiozetetes texensis and Tyrannus melancholicus) twittered excitedly; Derby flycatchers (Pitangus) cried hip, hip, hurray; gold and black orioles whistled like school-boys homeward bound; anis whined; golden-fronted woodpeckers coughed; and ever and again the big Mexican pileated woodpecker sprang his thumping, reverberating rattle with astonishing effect.

A DREAM COME TRUE

It was such a scene as one might well have dreamed of, but scarcely expect to find when waking; nor did it altogether fade with the rising sun. These birds were not only feeding, but living, near us, and when their early morning hunger was satisfied many of them were found to be nesting, or preparing to nest, within sight of our tent.

A ground dove sat calmly on her two white eggs in the heart of a small orange tree at the ranch-house door; a red-hilled pigeon, for some reason dissatisfied with the site in which its nest was built, was moving it twig by twig to a new situation in a limb above our tent; a pair of pileated woodpeckers had taken possession of a dead trunk about 150 feet from camp, making the entrance to their nest directly beneath a large projecting fungus, which served as an admirable hood to their doorway; yellow - headed parrots were prospecting for a homestead in a dead tree on the river shore, and appeared and disappeared in its hollow limbs in a manner which seemed to indicate they felt at home; while a pair of red-capped parrots were evidently much annoyed to find that a cavity which appeared to be acceptable was already occupied by a lizard about 2 feet in length, who refused to be dislodged, but continued to bask quietly at his threshold with, no doubt, irritating

Three factors accounted for the abundance and familiarity of the birds about our camp in the ranch-house clearing: First, the larger forest trees had been left stånding and only the undergrowth cut out; second, many of these trees, locally known as "otaheite," were bearing fruit of which parrots and some other birds were particularly fond; third, the birds were not molested.

To see the species which required either undergrowth or wholly primeval conditions, it was necessary only to climb the corral fence, 200 yards away, and enter the forest on its farther side. The trees were not high, but the growth was dense, and in places the ground was covered with wild pines having leaves bordered by a series of strong hooks, which, set in both directions, were more productive of

eloquence than progress when one attempted to leave the forest path.

BOLD AND TIMID BIRDS

Here, if one could avoid the big brown jays (*Psilorhinus*), which, with jerky; flight and raucous calls, followed one with maddening persistence, he might find the copper-tailed trogon and hear its flickerlike coo or detect the elusive, echo-like hoot of the mot-mot; and in the early morning the air vibrated with the soft, conch-like cooing of the semi-terrestrial white - fronted dove (Leptotilla), while chachalaccas rattled, woodhewers (Dendrornis) piped, wrens of several species called or sang from the lower growth, and overhead there were warblers, tanagers, and vireos, some on their way north, others preparing to nest.

The banks of the river were too high, and too continuously wooded to be suitable for water-loving birds, and the river is memorable to us chiefly as a fly-way of the splendid Muscovy duck, wild ancestor of a much degraded barn-yard descendant

No one lacked for occupation at Paso del Haba. Shiras hunted with camera by sunlight and flashlight, securing photographs of birds by day and of beasts by night, and left, no doubt, a more vivid and lasting impression on the minds of two natives who unwittingly sprang one of his flashlight camera-traps than even his dry plate recorded.*

The naturalists added to their store of notes and specimens, while the keen, discriminating ear of Fuertes led to the discovery of a surprising new species of oriole, possibly the ancestral form of our familiar orchard oriole.

ORNITHOLOGIST'S PARADISE

Given the same considerate host who made our stay at his home so care-free, and hence productive as well as enjoyable, and somewhat more stable governmental conditions than have lately prevailed in this vicinity, and I know of no place where an ornithologist might hope to learn more of the habits of many tropi-

* See the article by Mr. Shiras in NATIONAL GEOGRAPHIC MAGAZINE, July, 1913, "Wild animals that took their own pictures by day and by night," page 807.

cal species concerning whose home lives we know as yet little or nothing. Of the 88 species recorded by us during the week of our stay, no less than 36 are tropical forms, which are here at, or near, the northern limit of their range.

This fact in distribution, together with the specimens to confirm it, filled our present wants, and we returned to Tampico to continue our reconnaissance in the tropical fauna among the water birds of the Tamiahua lagoon to the southward.

A canal which had lately been completed from the Panuco River to the northern end of the Tamiahua lagoon gave easy access to that large body of water. Having now to supply our own launch, several days were lost in overcoming the numberless obstacles which invariably confront the hurried traveler in the tropics, but the importance of actually starting induced us to leave Tampico at 3.30 in the afternoon of April 11 rather than wait until the following morning.

Sunset found us still in the canal and we were forced to camp for the night on the lately erected mud-bank which formed its shores—a site fully demonstrating the importance of a tent with a permanently attached water-proof floorcloth. There were a few ducks in the bordering mangrove swamps. Fuertes killed three blue-winged teal soon after we landed, and a pair of gadwalls, which took wing as he fired, were dropped, if not literally in our pot, at least in the fireplace.

The spot was a good one to leave, and we were off early in the morning on our run to the southern end of the lagoon. Great brown rail (Aramides), Muscovy ducks, and black-necked stilts were among the noteworthy birds about us, while an astonishing number of coots (Fulica) were found resting on the long jetty-like arms which carry the canal to deep water in the lagoon. With explosive, protesting cucks they pushed off into the water, forming, finally, a solid black raft seemingly several acres in extent. Along the shore there were a few canvasback, gadwall, and shovelers; but most of the ducks had evidently left for the north, and birds as a whole were far from common.

With anticipations of better things beyond, we puffed along as rapidly as a head wind and two towed row-boats laden with gasoline, provisions, and camp equipment would permit. Our objective point was the home of a certain Indian hunter whom Charles Sheldon had told me could give us all needed information about bird life in general and roseate spoonbills in particular; but it must be admitted that the fact I had forgotten the man's name and mislaid the notebook in which it was recorded rather clouded our immediate future.

However, when we landed on the eastern shore of the lagoon for the night we learned from a troop of small Indian boys, who gravely shook hands with each one of us as we stepped ashore, that a thatched but on a near-by bluff was the home of the man we had been blindly seeking. "Maclodeo" was the name to which a dormant memory instantly responded.

A JUNGLE VISITING CARD

Maclodeo proved to be absent hunting alligators, but when, the following morning, I introduced myself to his wife as a friend of "el Americano Don Carlos" a flash of comprehension illumined her previously puzzled features, and hurrying into the dimness of her thatch she quickly returned with a small, still white and evidently precious bit of cardboard, on which was engraved "Charles Sheldon, Madison avenue, New York City," a treasured memento which completed the identification of Maclodeo!

Information now came readily, and we learned that not only spoonbills, but several other species of birds were nesting on a group of small islets about 10 miles farther south. In spite of our ardent desire to see these birds, our surroundings were too attractive to leave without at least a casual exploration.

The peninsula is here about 10 miles in width, and in place of a growth of acacias, cacti, and other xerophytic plants, such as characterize the coastal plain to the north and to the south, it is for the greater part covered with a forest of surprising luxuriance. The common occurrence of fresh water at a depth of not more than two feet indicates that

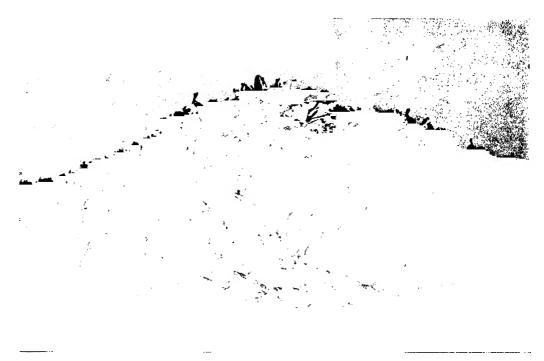


Photo by Frank M. Chapman

PELICANS IN BLACK MANGROVES IN TAMIAHUA LAGOON, MEXICO

this forest has appeared in response to a natural subsurface irrigation. However this may be, the fact remains that at this point luxuriant tropical forest growth reaches its northern limit at sea-level, a circumstance which implies that one may expect to find here many species of plants, birds, and mammals heretofore known only from farther south, as well possibly as some local forms.

AN UNEXPLORED REGION

The region is practically unexplored zoölogically, and offers an attractive as well as a readily accessible field to the faunal naturalist. Purely as a bit of pertinent information, it may be added that no one should attack it who is not proof against mosquitoes and the small ticks, locally known as "pinaleas."

A day near Maclodeo's added to our list of purely tropical species a third parrot, a tinamou (Tinamus), a great cacique (Gymnostinops), a hawk (Rupornis), a falcon (Falco albigularis), a toucan (Ramphastos), a flycatcher (Megarhynchus), blackbirds of the genera Amblycercus and Dives, tanagers of the

genera Saltator and Phanicothraupis, and flycatcher-like birds of the genera Lathria and Platypsaris.

Even this encouraging and suggestive showing could not induce us longer to postpone our visit to the bird islands. Possibly, too, our departure was in a measure hastened by the ticks and mosquitoes, and on the morning of April 14 we continued our voyage, and two hours later landed on Pajaro Island in a tiny cove, with a sand beach overhung by black mangroves—a most attractive camp site. The beach, some 50 feet wide, was bordered by lower, grass-grown, evidently at times marshy, but now dry, ground, and on the other side of this lay a still lower area several acres in extent, covered with black mangroves and other low trees and bushes growing in water.

Up to this time few birds and no spoonbills had been seen; but giving no expression to our disappointment or to our rapidly changing estimate of Señora Maclodeo's veracity, we crossed the narrow marsh and entered the wall of vegetation on its farther side.

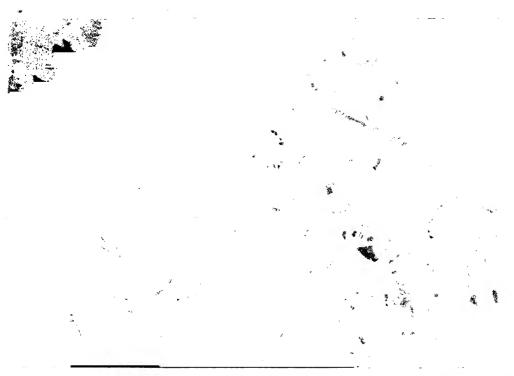


Photo by Frank M. Chapman

A REDDISH EGRET, NOT PHOTOGRAPHED BEFORE

A BIRD PARADISE

If we had suddenly opened the door of an overcrowded hen-house and thrown a bomb within, the change could not have been greater or the effect more surprising. Hundreds of birds which had been quietly resting at mid-day, with squawks of alarm, sprang into the air, and for a moment we were dazed by the confusion about us. But among the numberless herons of several species we could see dozens of delicately colored pink forms, while in nearly every tree was one or more nests holding young nearly as large and as pink as the parents which had just left them. We had at last reached the home of the spoonbill (see pp. 548-550).

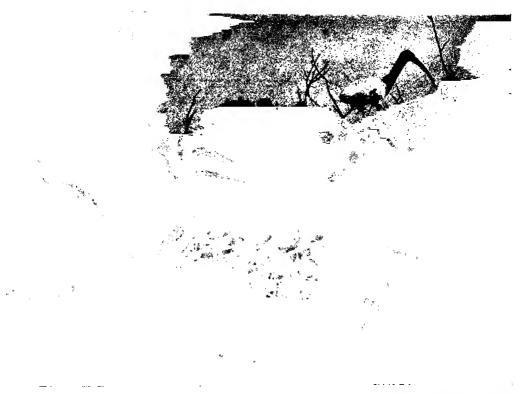
Further exploration revealed a surprising number of birds on the island. There were Louisiana and little blue herons in great abundance, a few reddish and American egrets, black-crowned and little green herons, wood ibis and black-necked stilts, snowy banks of white ibis, and probably 200 pairs of roseate spoonbills. Nearly all were nesting, and it was ob-

vious that we had before us an unusual opportunity to record photographically, both with motion film and fixed plate cameras, the appearance and habits of some little-known birds.

We first directed our attention toward the spoonbills, the most difficult, as well as the most valuable, subjects before us. Satisfactory studies could not be made from below, and the trees were generally too small to furnish support at the desired height, and before a proper location was found and the umbrella blind and cinematograph placed in position our strength, if not patience, was fully spent.

SACRIFICED TO FASILION

The odor from the decaying bodies of white egrets which, stripped of their plumes by hunters, had been thrown into the semi-liquid mud of the rookery, of their dead young in the nests above and water below, of the fragments of food and sundry débris of a great gathering of birds, the extreme heat—the mercury reached 99°—and the abundance of mos-



WHITE IBIS AND YOUNG

Photo by Frank M. Chapman

In the right foreground an ibis is feeding its young, which are, however, protectively colored and almost invisible in the photograph (see text below)

quitoes furnished as many elements of discomfort as one often encounters at one time, and all were intensified within the blind; nevertheless I can recall only one other experience in bird study which has afforded me keener pleasure or more lasting satisfaction.

To go into detail is not possible at this time, and it may simply be stated that a series of plates and motion films were made illustrating the home life of the roseate spoonbill, valuable not only because they had not been made before, but even more valuable because, owing to the diminishing numbers of this rare bird, they may possibly never be made again.

The white ibises were nesting in low bushes under conditions which made photography as easy with them as it was difficult with the spoonbills. One had only to erect one's blind in the open spaces their nests faced and enter it, when forthwith the routine of ibis life was resumed.

The young ibis were almost ready to fly and in their wood-brown plumage were as invisible as their parents were conspicuous. In photographs containing dozens of them only one or two can be clearly distinguished, and even in the motion pictures obtained they can be discovered with difficulty.

AFTER THE IGUANA

I had exposed my last plate on them one day when I observed a heavy-bodied iguana, about 4 feet in length, with his armor of plates and spikes fully developed, slowly climbing about among the nests, pausing here and there to eat leaves. The birds paid no attention to him and he was at least not an unwelcome guest. Being unable to photograph this venerable-appearing reptile, I determined to catch him, and before he realized my presence I was almost within grasping distance (see also page 558).

At that moment he took in the situa-

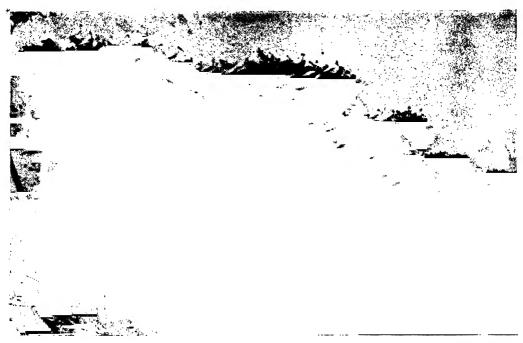


Photo by Frank M. Chapman

A FLOCK OF IBISES: TAMIAHUA LAGOON, MEXICO (SEE PAGE 545)

tion, half fell, half jumped to the ground, and at top speed galloped over the mud to the lagoon, 50 yards away, and plunged into the water not 2 feet ahead of me. I have not yet made up my mind what I should have done with the formidable-looking reptile if his speed had not outrun my discretion. Iguanas were, in truth, surprisingly common on the little island. The track of their dragging trail was everywhere visible along the beach, and we were frequently startled by having them drop from the limbs overhead and scurry into the water.

DIRIGIBLE AND AËROPLANE

On some neighboring islets brown pelicans and man-of-war-birds were nesting in the black mangroves. The latter were so wholly devoid of fear that in order to secure motion pictures of them in flight it was necessary to shake the limbs on which they were sitting. The mating season was past and the birds were incubating their single white egg, and but one bird in the colony of several hundred was seen to inflate its throat pouch.

This form of sexual display is practiced only by the male, who expands his

pouch until in form, color, and appearance it exactly resembles a red toy balloon. This striking appendage is exhibited not only when the bird is at rest, but also when it is in the air, and we secured photographs of a flying bird with this great scarlet bladder hanging beneath its bill—a unique combination of dirigible and aëroplane in bird life (see page 551).

Without further describing our search for land and water birds at sea-level in eastern Mexico, or summarizing what I have briefly written about them, at least enough has been said to show that in its general aspects the avifauna is here highly tropical. Accepting this fact as established, we may now return to Vera Cruz and begin our journey toward snow-line.

Remarkable as is the railway journey from Vera Cruz to the table-land, it must be remembered that the region has been settled for centuries and that the original forest has long since disappeared. To find primeval conditions one must therefore go some distance from the long-established railways. In my opinion the whole region may best be seen from Cordoba as a base. The city itself is unusually interesting, the accommodations good,



WIIITE IBIS: TAMIAHUA LAGOON Photo by Frank M. Chapman

the climate agreeable, the surroundings picturesque, the vegetation luxuriant, the inhabitants thoroughly Mexican, and the views of Mt. Orizaba of surpassing beauty. A railroad leads not only toward both coast and table-land, but another line goes south, and still another goes north. Cordoba, with an elevation of 2,700 feet, is near the upper edge of the humid Tropical Zone, and in an hour or two one may go by train to the heart of the tropics below or to the Temperate Zone above.

BEAUTIFUI, ORIZABA

But Cordoba deserves chiefly to be known as the place from which Mt. Orizaba may best be seen. From no other spot known to me is one more impressed by the dominating majesty of this great mountain. Towering more than 15,000 feet above one, its superb, sweeping, symmetrical outlines can be seen from flank to flank, from foothill to summit. A single view of this great volcanic cone

will enrich the remaining years of one's life with a precious memory. To be long enough with Orizaba to experience the ever-changing but never failing demands it makes on one's love of the beautiful and sublime, and to realize its power to stimulate one's spiritual nature, is an abiding inspiration.

Further studies of the life of the Tropical Zone were made at Motzorongo, 30 miles to the south, on the lately opened railway to the Isthmus of Tehuantepec: Here we found as highly developed tropical forest as I have ever encountered, and, in addition to many forms of tropical birds, tapirs and monkeys are said to inhabit it. Finally, our work in the Tropical Zone completed, we turned our faces toward the snows of Orizaba or, to be more exact, toward the clouds of Orizaba, for in consequence of a norther which had prevailed for a week we had been surrounded by fog and drizzling rain, and the mountain had been invisible.

The summit of Orizaba can be reached

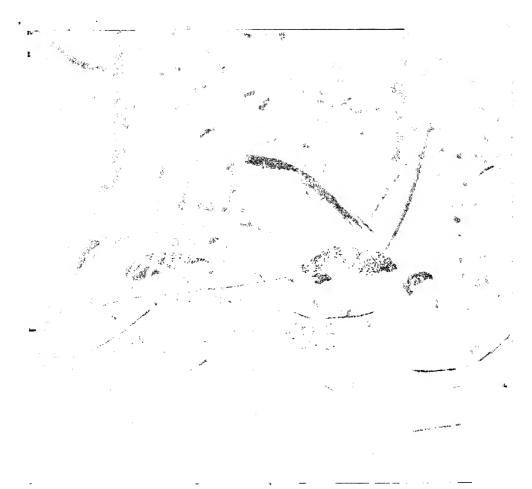


Photo by Frank M. Chapman

SPOONBILLS: NOTE THE PECULIAR BILL, WHICH GIVES THE BIRD ITS NAME

without great difficulty from the edge of the table-land through San Andres and Chalchicomula. One may travel to an altitude of 15,000 feet by mule, and the remaining 3,000 odd feet are traversed on foot. No physical obstacles are encountered, and the walk to the top is merely a matter of legs, lungs, and heart. To accomplish our purpose of determining the approximate limits of the life zones through which one passes in traveling from sea-level to snow-line, a less frequented and more direct route was desir-. able, and we determined, therefore, to begin our ascent at Coscomatepec, a quaint and but little-known town at the bottom of the foothills lying at the eastern base of the mountain.

Coscomatepec is 2,200 feet above Cordoba, at the terminus of a railway 20 miles in length. The journey is made in three hours, the train leaving Cordoba at 7 a.m. and Coscomatepec at 12.30 on the return trip.

"DOCE" AND "DOS"

Mistaking "doce y media" (12.30) for dos y media (2.30), our prospecting party missed the train for Cordoba by nearly two hours and we were forced to spend the night at Coscomatepec. With an outfit of lenses, guns, etc., worth several hundred dollars, our cash assets barely sufficed to buy us the humblest board and lodging and second-class passage to Cordoba in a freight car overcrowded with



FEEDING UNDER DIFFICULTIES

Photo by Frank M. Chapman

"We could see dozens of delicately colored pink forms, while in nearly every tree was one or more nests holding young nearly as large and as pink as the parents which had just left them. We had at last reached the home of the spoonbill" (see text, page 544).

natives. This last circumstance so shocked an English salesman that with difficulty we prevented him from buying us first-class tickets.

Several days later Fuertes and I, with W. F. Patterson, a fellow-member of the Explorers' Club, who, finding us at Cordoba vainly searching for a cook, had volunteered to fill the position (which, I may interpolate, is now permanently open to him!), left Coscomatepec with three saddle and two pack animals. Mist and clouds obscured all but the near-by land-scape. The trail was good, but as slippery as though soaped, and the animals fell with discouraging frequency. We were now in the Temperate Zone, a re-

gion favorable alike for man and maize, and hence so populated and cultivated that the original growth has long disappeared.

The last mango trees and coffee plantations were left at 4,700 to 4,900 feet, and at 5,000 feet the trail was bordered by great sycamores. Within the succeeding 500 feet we saw hawthorn blooming, wild ("rum") cherry trees with green fruit, poplars, and oaks; and these trees, with willows, peaches, pears, apples, elderberries, huckleberries, and lupines, were characteristic of the zone through which we were traveling.

Few birds were or could be seen, but the presence of robins and flickers (both

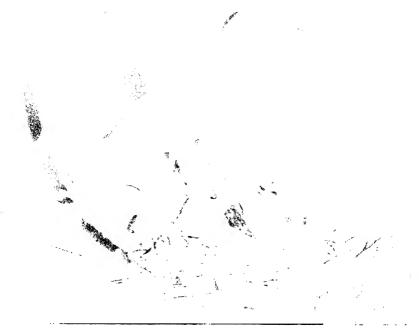


Photo by Frank M. Chapman

SPOONBILL AND YOUNG IN NEST: TAMIAHUA LAGOON (SEE PAGE 544)

of the western variety) told us that the fauna as well as flora had changed.

Toward mid-day the trail took the crest of the thin ridge between the deep Jamapa and Tlacotiopa barrancas. Dense clouds were below as well as above us. We seemed to be climbing a knife-edge through space. Reaching level ground on what might have been another planet, we camped for the night. Shortly we were visited by a group of seemingly pure-blooded Indian boys from neighboring cabins or jacales, who appeared as much excited by our presence as though we had come from another planet. Particularly were they interested in Patterson's masterly handling of flapjacks, doubtless to them a kind of glorified tortilla, and we ourselves were not without admiration of his skill, and especially its productiveness.

WAKING IN THE CLOUDS

We awoke in the clouds, and all day they hung closely about us. Huts of hewn boards roofed with split shingles, without windows, and with an unhinged door leaning against their one opening, were passed at intervals. At our approach their owners promptly disappeared within, and although our passing greeting was usually answered, the speaker was unseen, but we could almost feel the questioning look of at least one pair of eyes. They were rather an attractive-looking people, with the ruddy olive complexion one finds among the Indians of high altitudes.

At about 9,000 feet we reached the upper limit of corn, and in consequence the upper limit of human habitation. Beyond this point only goatherds and iceminers were encountered. At the same time we entered the outskirts of the coniferous forests of the Boreal Zone.

PERPETUAL TROPICAL WINTER

A few outlying short-leaved pines (*Pinus montezumæ*) had been seen as low as 5,700 feet, and the pine forests descended at least as low as 8,000 feet. At 9,300 feet we encountered the first spruce (*Abies religiosa*), convincing evidence of the boreal character of our sur-

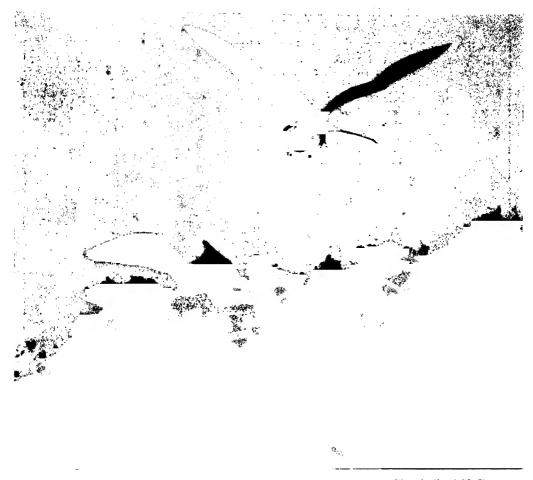


Photo by Frank M. Chapman

AN UNUSUALLY RARE PHOTOGRAPH: IT SHOWS A MAN-O'-WAR BIRD WITH POUCH INFLATED (SEE PAGE 546)

roundings, and at 9,500 feet we camped in a superb primeval forest of pines, spruce, and oak. The pines (Pinus montezumæ and P. liophylla) compared favorably in size with those of the California Sierras, while some of the oaks, locally termed "encimos," we estimated to be 130 feet in height, with a basal diameter of 6 feet.

A singularly incongruous tropical note in this Alpine forest was the presence of Spanish "moss" (Tillandsia), which in places heavily draped the trees, and crimson-spiked "wild pines," which in abundance grew from favorable root-holds on their branches. The high degree of moisture prevailing in this zone of clouds evidently creates such favorable conditions of humidity for these epiphytes that they have adapted themselves to a much lower temperature than they could endure under dryer conditions.

At night, enshrouded by the now chilly mist, we sat closely around our camp-fire discussing the prospects of better weather, when, doubtless through a change in the direction of the wind, by us unnoticed, the clouds with surprising suddenness disappeared, and almost as quickly as one would turn on a light the once ghostly forest was brightly illumined by the rays of a full moon! The effect was thrilling, but when we looked upward through the pines and saw, impressively near, the snow-crown of Orizaba gleaming brilliantly, serenely in the moonlight, we were overpowered by an emotion which for a moment left us speechless.

The weather had cleared and in a manner which made the experience the most memorable one of our journey. The following morning was cloudless, and as a reminder that we were in the Tierra Fria the mercury stood at 31° and ice formed

in pools left by the rain.

When contemplation of Orizaba permitted we could now take some account of our surroundings. The ridge between the barrancas had narrowed again and on each side we could hear the roar of the over-filled streams tearing down their rocky bottoms, 1,500 feet below us.

BIRDS OF THE NORTH

Birds were common, easily observed, and of absorbing interest. One may read of the occurrence of such typically boreal species as evening grosbeaks and crossbills in the latitude of Mexico City without discounting the impression created by actually seeing them there. Brown creepers (Certhia), nuthatches (Sitta pygmæa and S. carolinensis mexicana), chickadees (Penthestes meridionalis). water ousels, juncos (Junco phæonotus), siskins, ravens, and hairy woodpeckers were other birds of northern origin seen about or near our camp, while robins, bluebirds, and flickers served further to remind us of higher latitudes. More strictly indigenous forms were olive, and red-faced warblers and the large striped sparrows (Plagiospiza).

At an altitude of 10,000 feet we passed a group of buildings locally known as El Jacal, the home of a patriarchal goatherd whose family appeared to be almost as numerous as his flocks. Here the traveler from Coscomatepec to San Andres on the table-land could lodge for the night. The trip therefore may readily be made without other equipment than one could carry on his saddle, and I commend it to every one who would leave the tourist trail and come into closer contact with Mexico than is possible near the line of a railway.

At 11,500 feet the last spruces were observed. At their "timber-line" they

were still large, vigorous trees and there was no apparent reason why they should not have continued to appear for at least another thousand feet; but, if unseen, the law that controls their distribution was not the less potent. Shortly they were followed by the long-leaved pine (Pinus liophylla), and only the short-leaved pine reached the upper limit of tree-growth.

Camp was made at 12,600 feet, in an ill-selected spot, where, after sunset, the wind swept down off the great snowfields above us and we could actually see the mercury in our thermometer fall. In 30 minutes it dropped 28°-from 48° to 20°—and at 6 o'clock the following morning it registered 12°. Lack of suitable clothing, though we had prepared for reasonably cold weather, and the suddenness of the change gave us, in spite of a camp-fire, a realizing sense of what it means actually to suffer with cold. hours later the sun temperature was 112°, and, suffering now from the heat, we endeavored to adjust ourselves to a variation of 100 degrees in six hours.

MASTER OF THE MOUNTAIN

Long before daylight, on this wakeful night, we heard the tread of sandaled feet and the sound of surprisingly cheerful, laughing voices pass on the trail which led up the mountain. Who these people were and where they were going was later explained to us by a visitor, who, armed with an ancient rifle, politely introduced himself as "el dueno de la montaña" the master of the mountain-and intimated that in the performance of his duty he would be grateful if we could explain to him the object of our visit to this region in which strangers were rarely seen. Were we Germans? he asked. No; from the United States, we said. "Ah, Englishmen," he replied, and we let it go

He was the handsomest, most attractive specimen of native manhood I have ever set eyes on. I had an absurd desire in some way to "collect" him, and only a realization of how sadly out of place he would be far from his own habitat restrained me from the attempt.

His conquest was completed by Patter-

Photo by Frank M. Chapman

SCENE IN THE TROPICAL FOREST NEAR VERA CRUZ AT AN ELEVATION OF 800 FEET

"One can actually stand in a tropical jungle, where parrots, trogons, toucans, and other equatorial birds are calling from the liana-draped trees, and look upward to forests of pines and spruce, where crossbills, juncos, pine siskins, and evening grosbeaks are among the common permanently resident species" (see text, pages 537 and 552).



Photo by Frank M. Chapman

A MOUNTAIN OAK (ALTITUDE, 9,500 FEET) UNDER WHICH WE CAMPED

"We camped in a superb primeval forest of pines, spruce, and oak. The pines (Pinus montecuma and P. liophylla) compared favorably in size with those of the California Sierras, while some of the oaks, locally termed 'encimos,' we estimated to be 130 feet in height, with a basal diameter of 6 feet" (see text, page 551).

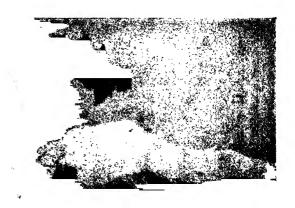


Photo by Frank M. Chapman

IN THE PINES AND HEMLOCKS ON THE SLOPES OF ORIZABA

"The clouds with surprising suddenness disappeared, and almost as quickly as one would turn on a light the once ghostly forest was brightly illumined by the rays of a full moon! The effect was thrilling, but when we looked upward through the pines and saw, impressively near, the snow-crown of Orizaba gleaming brilliantly, serenely in the moonlight, we were overpowered by an emotion which for a moment left us speechless" (see text, pages 551 and 552).



Photo by Frank M. Chapman

ICE MINERS ON ORIZABA: 13,200 FEET

son's flapjacks, and we learned that, representing the owner of the region, his duties were to permit only those to cut wood or mine ice who paid for the privilege. The men who had passed our trail, it appeared, were on their way to the ice deposits near the head of the Jamapa This cutting of ice near the barranca. summit of Orizaba to take to the hot lands at its base is a primitive industry which appeals to one as an eminently practical demonstration of the effects of altitude on climate, and to see it practiced we followed the trail of the cheerful little men from the tropics

Crossing rock-slides where pikas would have been at home, we passed timberline, which on the northern slope of the barranca was at 13,000 feet, but on the southern slope appeared to be at least 800 feet higher. The short-leaved pine was the only tree occurring here, and to the last it stood erect, was symmetrical, and attained a height of about 30 or 40 feet, or about one-half its maximum size.

A CITY'S ICE SUPPLY

Where the barranca narrowed until it seemed a mere crack in the mountain we found a burro staked, and a short distance farther heard voices and the musical sound of cutting ice. We had traced to its source the original "nieve" which a thousand times itinerant peddlers had nasally invited us to "tome" (take) in the streets of Cordoba. Cordoba, it is true, is now supplied with artificial "nieve," but Huatusco and other towns to the north not reached by rail still draw on the deposits of Orizaba.

The men were working at an isolated pocket of clear, crystal ice about 100 feet above us. With serapes thrown over their heads for protection from the rays of the sun, and apparently not affected by the altitude, which made us avoid unnecessary exertion, they vigorously chopped out blocks weighing about 75 pounds. With the aid of a lariat these were carefully lowered down the steep

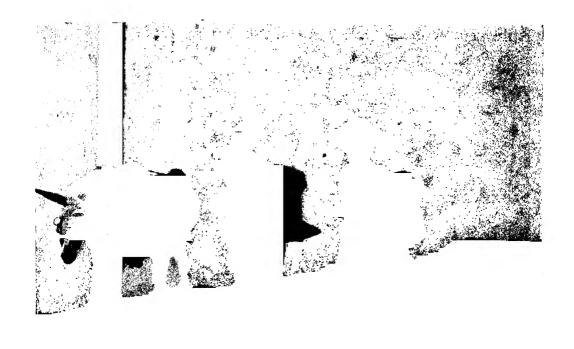


Photo by Frank M. Chapman

PACKING ICE FROM ORIZABA: A CLOUD-FILLED CANYON BEHIND

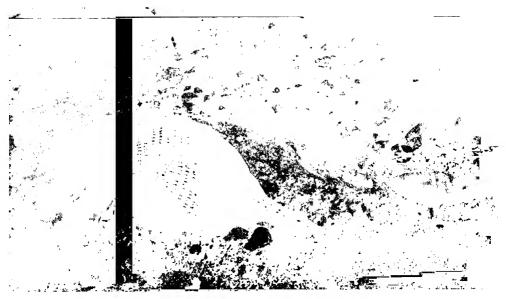
decline to the floor of the barranca, there to be wrapped in saccate grass and old serapes.

Late that afternoon these men trotted past our camp, now at 10,000 feet, on their way to the tropics. Each one carried a great cake of ice on his back, and the burro had two. Mentally we followed them in their journey, and the experience was properly rounded when several days later the first sound that greeted us as we stepped off the train at Cordoba was the familiar "tome nieve" of the ice-cream yender.

The dueno de la montaña assured us that El Pico had never been ascended from this side, thereby quickly extinguishing whatever ambition we may have had to climb to the summit. Our task indeed was finished when we reached the upper limit of life, and with the collections made below we now had specimens of birds, trees, and plants, paintings, photographs, and data with which to construct our proposed Habitat Group of Mt. Orizaba as seen from the Tropical Zone at its base.

In due time this group was completed, and it stands, let us hope, for all time as a not inadequate representation of a mountain which, whether seen from the sea as a sun-kissed cloud, from the low-lands as a sky-piercing cone, or from the pine forests as a massive, glittering dome, always compels the homage we render a great personality.





THE NINE-BANDED ARMADILLO IS COMMON IN MOST PARTS OF MEXICO

Its bony armor is rather a protection against the thorns of the dry country in which it lives than against the attack of large carnivores, which can readily bite through the joints



Photos by Dr. C. William Beebe

PAPER NEST OF MEXICAN WASPS BUILT ON A CACTUS PAD

The insects are small, but very savage, and with exceedingly venomous stings, and if disturbed by a lizard running past will attack one without further provocation



Photo by Dr. C. William Beebe

THE RING-TAILED CAT, OR BASSARISCUS, WHICH PROWLS AT NIGHT ABOUT ONE'S TENT IN THE ARROYOS OF MEXICO

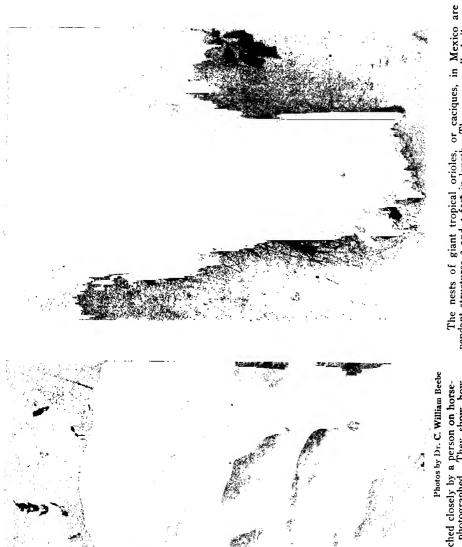
It is somewhat related to the raccoons, but shows close affinity to fossil dog-like creatures which lived in the Oligocene. The tail can be fluffed up until it is as large around as the body.



Photo by Dr. C. William Beebe

THE LONG-TAILED MEXICAN OPOSSUMS ARE MOST ARRANT COWARDS

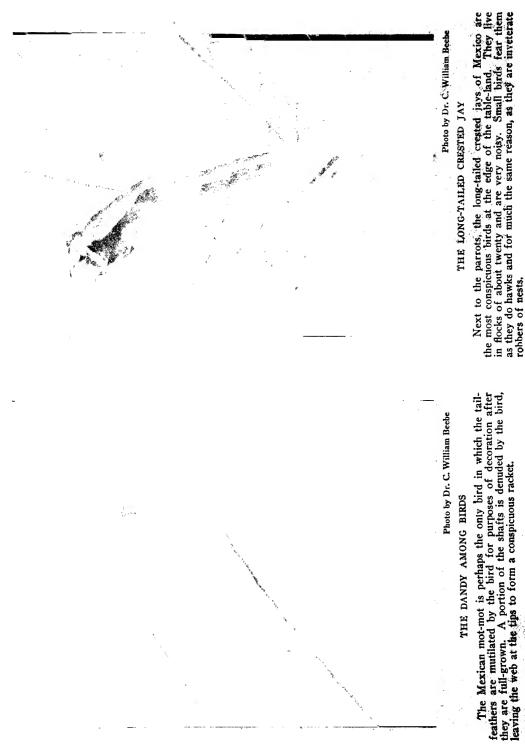
When cornered, they fall over in what appears to be the extremity of death—limbs stiffened, eyes glazed—and recover only when they think danger is past

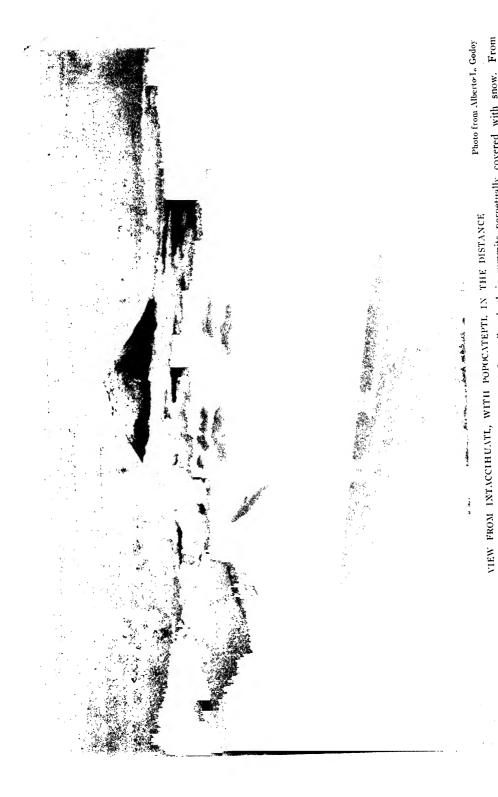


They show how flight may have been initiated in birds by leaping, sprawled out flat, from high trees. Their flesh is more tender and sweet than chicken Iguanas in Mexico can be approached closely by a person on horseback, from which position this was photographed. meat (see also page 545).

The nests of giant tropical orioles, or caciques, in Mexico are pendant structures 3 and 4 feet in length. They are usually built out on the very tips of slender branches, so that they are protected from the attacks of arboreal beasts of prey. Often, as in the above photograph, there is a little subsidiary chamber at the summit, which is used by the male bird as a roosting place when his mate is sitting on the

eggs below.





Standing guard over Mexico City are the great volcanoes, Popocateptl and Ixtaccihuatl, their summits perpetually covered with snow. From their heights, "the most imposing spectacle of all is the formation of the clouds below you"

A MEXICAN HACIENDA

Life on one of the Baronial Estates of our Southern Neighbor

B. J. E. KIRKWOOD

PROFESSOR OF BOTANY IN THE UNIVERSITY OF MONTANA

XTENDING southeastward from the Rio Grande, between high sierras on the east and west, is the Mexican plateau. About 250 miles in width, this area extends from Juarez to its southern extremity, about a thousand miles. Throughout an arid land, it lies under a clear sky and has few streams and little rain.

Its extensive plains are traversed at intervals by more or less isolated mountain ranges, mostly trending in parallel course with the Sierra Madre, which form its eastern and western walls. The mountains rise from 8,000 to 10,000 feet, but in the interior of the country they appear much lower, owing to the elevation of the plain itself, which increases in altitude from about 3,700 feet at Juarez to over 8,000 feet near the City of Mexico. The topography of this region is very similar to much of that of Arizona, New Mexico, and western Texas.

Though seemingly desolate, the land abounds in life, and the representatives of its fauna and flora occupy places in widely differing families of animals and plants. The country supports, however, a meager and scattered population, which, outside the cities, is concerned chiefly with mining and stock-raising. physically capable of a larger development agriculturally, this has not been possible under the system of land tenure which now obtains and has existed in Mexico from the early times of the Spanish occupation. The creation of enormous private estates, devoted to mining or grazing, and the domination of large sections of the country by the interests of a single individual or family have greatly hindered the growth of agricultural industry.

FEUDAL AND ARISTOCRATIC

The Mexican estate known as a hacienda is in some respects a remarkable

institution. Feudal in its traditions and aristocratic in its management, it reminds one of the old-world baronies of the middle ages. Consistent with political conditions in a country little more than nominally democratic, it is, nevertheless, so at variance with American ideals of liberty and equality that not the least of the interest in the system lies in the fact that such medievalism has flourished at our own doors up to the present time.

The story of the haciendas is one of romantic interest. Each, largely a law unto itself, developed its own institutions, had its life and activities apart from the rest of the State, and to all intents and purposes constituted a distinct social and economic unit.

The writer, not long ago, enjoyed the opportunity of a year's sojourn upon one of these haciendas. This estate, the Hacienda of the Cedars, is 70 miles long by 60 wide, a domain about equal in area to the State of Connecticut. Although much smaller than some of the other haciendas, it nevertheless constitutes a considerable property, being 2½ million acres in extent. From center to circumference is a day's journey or more, and the proprietor, when he visits the outlying portions of his estate, prepares for a journey of days or weeks with coach-and-six and attendants and much of the air of a petty ruler.

The Hacienda de Cedros, or, in more exact terms, the Hacienda de San Juan Bautista de los Cedros (the Hacienda of St. John the Baptist of the Cedars), lies in the northwestern corner of the State of Zacatecas. Mr. Charles T. Andrews, writing of life on a Mexican hacienda, says of this place: "There are several traditions in regard to the early history of the Cedros hacienda. One is that the original grantee obtained the land as a sort of subsidy for a missionary propaganda for 'the conversion of the Indians



Photo by J. E. Kirkwood

PEONS SHELLING CORN ON THE HACIENDA DE CEDROS

Ears are rubbed on blocks made by binding together corn-cobs. "One observing their farming in the outlying districts might imagine himself living in the days of the Pharaohs. The field is plowed with a crooked stick drawn by oxen, with the yoke tied to the horns. Grain is cut with sickle and threshed by the hoofs of cattle, and corn is planted and shelled by hand. Rough and heavy home-made carts or the backs of men or burros are the most common modes of conveyance. The people seem to have no appreciation of improved farming implements. Often when improved implements are provided the laborers they discard them for more primitive methods" (see text, page 573).

and the glory of the church.' There still remains indeed in the archives at Mexico a map of the hacienda with a sketch of the church building he proposed to erect. According to these plans, the sacred edifice would cover about five acres. The result was like some modern schemes for public aid to private enterprise. The promoter got 2½ million acres of land and the church got a building 40 by 60 feet.

"With less pious pretense, but by equally dishonest methods, a second purchaser obtained the property at a later period. For some reason, either through escheat or confiscation, the crown again came into possession of the hacienda and offered it for sale. An official in Mexico, taking advantage of the ignorance of the home government, represented the prop-

erty as simply a desert waste, very undesirable; but, 'in order to relieve the crown of an unsalable asset,' he magnanimously offered to pay 6,000 Spanish dollars for it as a virtual contribution to the support of the throne, and thereupon received a deed, with the thanks of the monarch for his loyal zeal!"

Some one who knew of the facts as they then were later endorsed the following on a blank page of the deed itself:

"This reprobate son of a degenerate father, . . . knew that besides rich deposits of minerals and large flocks of sheep and goats, the hacienda had at that time 30,000 head of beef cattle, which, to say nothing of the rest, the unmitigated scoundrel got for 20 cents apiece by outright and deliberate lying to his Most Catholic Majesty, the King of Spain."



Photo by J. E. Kirkwood

THE OLD SMELTER AT CEDROS

The slag piles in the foreground and the distance cover several acres. These piles are said to be of considerable value because of the large amount of mineral which the original process failed to extract (see page 577).

The Mexican Central Railroad crosses a corner of this estate at some distance south of Torreon. The station of Camacho, a sun-scorched and wind-swept row of adobe structures, is upon the hacienda, and eastward, over a distant range of mountains, lies the village of Cedros, the capital of this principality. Some 60 miles intervene, however, and to visit it one must proceed thither by horseback or wagon.

Cedros lies on the high border of a plain that reaches leagues long and wide to the west, north, and south. Eastward rises the range of the Potrero. On the horizon to the northeast are the furrowed slopes of the Zuloagas and to the west and southwest the Sierras de Zapoca and Guadalupe.

Thirty miles to the west the Zapocas rise as a mountain barrier along the whole horizon.

ENTRANCE TO CEDROS

Entering the hacienda from the east, this splendid panorama is gradually unfolded to view. When the afternoon sun is low and shadows are mounting the slopes, the slanting rays sweep the wide expanse with a glow of changing color. Rising out of the mountain chain, high above its fellows, stands a lofty peak, with its rugged crest outlined against the glowing sky. Clouds that rest upon it are tinged with gold and crimson and all the brilliant colors of a sunset such as This eminence, no other land knows. known as Pico Teirra, commands the whole of the surrounding country. Dark and rugged to its summit, which lies above 10,000 feet, its somber shadows are deepened by the thin growth of oaks and pines which clothe its higher slopes.

As the morning light strikes across the landscape, the watcher at Cedros may catch the glimmer of white at the base of Teirra, making faintly visible the hamlet of San Rafael. Half way to the peak across the intervening plain two small mountains stand as detached members of a lesser range at its southern extremity. Here a few dwellings comprise the village of Tecolotes, which, with a fortified inclosure and a water reservoir, marks a

station on the wagon road and is 17 miles away, though seeming but three or four.

Far to the northeast the plain reaches level to the horizon. Where the ranges converge in the distance the shifting mirage raises phantom hills which change in the glimmering heat, and remolinos—tall, slender columns of dust-laden whirlwinds—glide across the landscape and dissolve from view.

A SMALL CITY

Many small assemblages of huts or houses are scattered over the place and are the homes of small ranchers or herdsmen. In all, about 2,000 people live upon the Hacienda de Cedros. These are distributed about in small groups here and there, where springs may be found or wells dug, or where the configuration of the land makes possible the gathering of the rainfall into reservoirs.

Water is precious, and its relative abundance determines the size of the village and often the nature of its operations. Issuing from the limestone at the western end of the Potreros are a number of fine springs, some warm and others cold, providing for irrigation of the gardens, for the baths, and for household uses. Some supply the long, stone troughs where the herds come to About these springs has grown up the little town of Cedros, and the cottonwoods have grown with it, until across the country their spreading tops are visible afar and almost obscure the white walls of the buildings they overshadow. It is a rare oasis in a wide desert, and grateful shade here beckons the traveler to its restful shelter.

Here all roads lead to Cedros. Tenuous threads of white, cutting the dull green of the distant plain, can be seen converging to this point like the spokes of a wheel. The site, well chosen for strategic reasons, commands its approaches on three sides, while the rough slopes of the mountain lie to the rear. Precautions against Indians and others were necessary in the early days, and parapet and loophole are still visible in the construction of the larger buildings. Though such occasions are less to be ex-

pected now, the place is still well adapted to withstand a siege of small arms. The defenses here have somewhat fallen to decay; but at outlying stations some are yet well preserved, as where Cañada Blanca, with wall and battlement, furnishes a place of refuge in the grazing country two days' journey to the west.

The village of Cedros consists of the casa grande, or manor house, with its associated structures, and the church, the dwellings of the peons, a rope-walk (see pages 574 and 575), an old smelter (see page 565) and ore mills, and corrals. Aside from the casa grande and its grounds, the village does not cover more than the space of three or four city blocks.

HOMES OF THE PEONS

The homes of peons are either huddled in groups or scattered about the outskirts, and, though mostly permanent structures built of adobe, they are arranged in no definite order, but are set up wherever chance or the convenience of the builder dictated. Many of the dwellings have small adjoining inclosures formed by a paling constructed of the wand-like branches of the candlewood, serving for garden lots or corrals.

Cheer and comfort are scarcely known to the peons' habitations. They are usually without the luxury of windows, the door serving to admit all the light that enters. The poorer huts have merely a hole in the wall as a means of entrance and exit; sometimes a room adjoining has no exterior opening, but is reached by a hole in the partition.

In these hovels some live, begrimed and hungry, in hopeless poverty. Others of the dwellings are much better. Such may boast some coarse matting and rude home-made furniture and decorations of colored picture-cards and tinsel. In these the dwellers have some regard for cleanliness and a measure of self-respect.

The old church near the center of the village rises prominently above the surrounding structures. Standing upon an eminence, it gives prospect of the country far and near, and is itself first beheld by the approaching traveler. Its portal, shaded by graceful pepper trees, looks

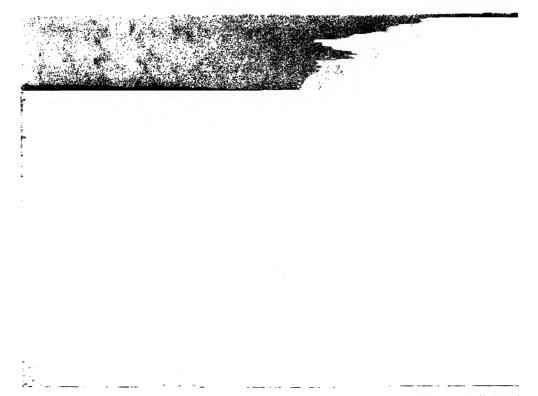


Photo by J. E. Kirkwood

The palma from which fiber is obtained. "This estate, the Hacienda of the Cedars, is 70 miles long by 60 wide, a domain about equal in area to the State of Connecticut. Although much smaller than some of the other haciendas, it nevertheless constitutes a considerable property, being 2½ million acres in extent. From center to circumference is a day's journey or more, and the proprietor, when he visits the outlying portions of his estate, prepares for a journey of days or weeks with coach-and-six and attendants and much of the air of a petty ruler" (see text, page 563).

A LANDSCAPE ON THE HACIENDA DE CEDROS

out upon the little plaza, witness of its people's life, at work or play. Rugged in its strength and severe in its architectural simplicity, it stands a refuge, spir-

itual and temporal.

The arched and cemented roof, walled round by a crumbling parapet, the loopholes of which still show, is reached by a flight of steep and narrow steps leading up on the outside. The walls of stone, 4 feet in thickness, are pierced by deep embrasured windows, which, being few and small, light but dimly the appropriately decorated interior. Guarding the entrance to this sanctuary are ponderous doors, whose mortised timbers are studded with huge wrought nails having heads the size of one's palm.

Through the center of the yard a walk

of flat stones leads up to the door, where the hollow-worn threshold speaks of the generations of devout people who have come and gone these 200 years. Within a large mural painting depicts the life and death of the martyred priest who long ago ministered to the charcoal-burners at Mazapil. Protesting against the oppression of these poor people, who then were slaves at the hands of their Spanish taskmasters, he aroused the anger of those whose greed he sought to check and lost his life at the hands of hired assassins,

THE MANOR HOUSE

Across the open plaza stands the casa grande. This relic of manorial pretensions of more prosperous days, with the buildings adjoining and appertaining to



A STREET IN THE VILLAGE OF CEDROS

Photo by J. E. Kirkwood

On the left the peons' quarters, on the right the garden wall. "The homes of peons are either huddled in groups or scattered about the outskirts, and, though mostly permanent structures built of adobe, they are arranged in no definite order, but are set up wherever chance or the convenience of the builder dictated" (see text, page 566).

it, rambles over several acres of ground. Its front elevation, like that of many other mansions of the land, is innocent of any suggestion of artistic effort, and rises a plain, white-washed wall, broken only by the deep-set and securely grated windows and the heavy doors. It rises 30 feet to the parapet, providing two stories in the main building, though its adjoining structures have but one. Before recent improvements substituted a stronger wall for the old parapet, loopholes were still visible here and there. The doors of the main entrance, like those of the church, are ponderously built of hewn timbers and, being barred, offer effectual resistance to any seeking entrance by force.

There seem to be no available records of the building of this house. A date legible upon one of the beams within is 1731, which appears to be the date of certain repairs. The building, however,

in essential respects seems as good as when first built. The lower walls are nearly 4 feet in diameter, though 2 feet, the usual thickness of adobe walls, afford ample protection against the burning heat of summer.

Notwithstanding the prejudice which might naturally arise against sun-dried brick as a desirable or durable building material, they have been immensely useful in many forms of construction over a large part of the North American continent. They came extensively into service, probably, through the force of necessity, where other materials were scarce or difficult to work, but they have abundantly demonstrated their usefulness. It would be difficult to imagine houses better adapted to the hot, dry climate of the plateau than the adobe, properly constructed, which, when well finished, is clean and may be even beautiful in design.

A PRETENTIOUS HOME

Entering the mansion by the main door, a portal large enough to admit a load of hay, one finds himself in a tunnel-like passage leading through to the inner court, or patio. On either side of this passage are doors, and farther on a stairway leads to the upper rooms, though originally they were reached through a trap-door by means of a ladder, which was drawn up at night.

The patio itself, some 60 or 70 feet square, is designed on the simple lines of some of the more primitive and isolated places, and from this court, after the usual fashion, doors open into various rooms. In the center of the patio a well furnishes water for the household, a flower bed occupies a cement basin of ample size, and a grape vine scrambles

over an arbor of rude poles.

Entering a door from the

Entering a door from the passageway, one finds himself in a large sala, or parlor, with tinted walls and tiled floor. tiles, perhaps at one time level, are now uneven after nearly 200 years of use. They are about 8 inches square, hard and smooth of surface. Such formed the chief flooring material in this and other houses of the time. Hewn timbers extend from wall to wall, supporting the floor above. The origin of these and much larger timbers in the construction of the buildings is a matter of some conjecture. Although it is reported that originally a cedar grove of considerable size grew here about the springs, there is at present no evidence that such a stand of timber formerly existed, except the few aged and decrepit junipers scattered along the feeble watercourses.

MUNITIONS OF WAR

A smaller room opening off the sala is an arsenal. Rows of Winchesters are stacked along the wall, some of recent, others of older, models; also some ancient muzzle-loading pieces of ponderous weight. Revolvers and pistols of ancient pattern complete the assortment, along with a small supply of drugs and medicines

Passing out at the other end of the sala, one enters a corridor, at the far end of which glazed doors give access to the

huerta, or garden. Off this corridor rooms open to the right and left, but, as none of these are of special interest, attention may now be turned to the kitchen, entrance to which may be gained from the patio. This room, 20 feet square, is lighted during the day through the open door.

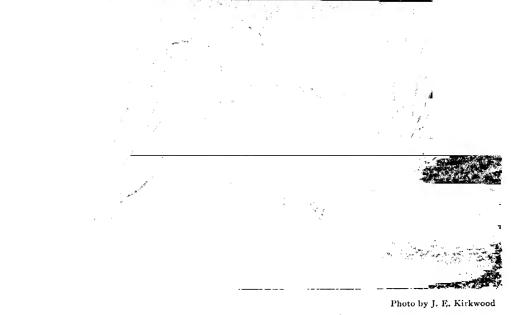
In the center of the room was originally a circular, altar-like structure of stone or adobe, 6 feet across, from which arose a huge conical chimney, supported by several legs forming the sides of as many arches. Upon this bench, prior to the advent of the modern range, cooking was done by the open fire. From the kitchen food was carried by an out-of-door route to the dining-room, there being no connecting passage.

Adjoining the main building a long row of lower structures flanks the plaza. Among the several doors along this row two are noteworthy—one gives entrance to the jail, the other to the wine cellar. The juxtaposition of these two institutions probably was not meant to convey any idea of their logical association, but that one of these sometimes contributed to the other there can be no doubt.

A GREAT WINE CELLAR

The commodious vault of the wine cellar is reached through several outer rooms containing the various appurtenances concerned with the manufacture of wine. Huge fermenting vats built of adobe and lined with cement, each capable of holding several cartloads of grapes, stand close by the press in one of the outer rooms, and in another a still was built close by the steps which lead under a high and heavy archway down to the cellar. The cellar itself, about 100 by 40 feet, is divided lengthwise by supporting arches of the same masonry which figures in the construction of all the buildings.

Along the walls stand rows of huge casks, most of them now empty, but some containing a few gallons of the more recent vintages. Midway of the cellar a well reaches down to a flowing spring, whence water was drawn for uses in connection with the winery. As indicated above, not only fermented, but also distilled, liquors were manufactured here,



LECHUGUILLA PLANTS (THOSE HAVING NARROW LEAVES) AND CACTUS ON THE HACIENDA DE CEDROS

This and page 567 show the typical vegetation of the region. The lechuguilla is about 18 inches high. "Two kinds of fiber are produced in large quantities. One is from the leaves of a yucca-like tree commonly called by the natives palma, and the other goes usually by the name lechuguilla, and is derived from a small relative of the century plant, exceedingly abundant throughout the northern half of the Republic. The fiber is soft, pliable, and strong and is much used for cordage, matting, bags, etc. Some of the fiber is manufactured locally, but the most of it finds a market in New York and other foreign ports" (see text, page 577).

wine and aguardiente, a kind of brandy, being the chief products.

From the wine cellar one may enter the garden pertaining to the casa grande. This garden, about 40 acres in extent, is surrounded by an adobe wall 10 feet in height, forbidding entrance to those not of the casa. Given somewhat to arbors in the vicinity of the house and to walks roughly paved with cobblestones, where are also fig and pomegranate trees, cottonwoods and pecans, the larger part of this extensive garden was formerly utilized in the growing of grapes.

MOVING A GARDEN

We are told that the earth of this garden is not its original soil, but was carted onto the area to provide the necessary conditions for the growing of crops, and the story has at least the appearance of truth, inasmuch as the soil within is different from that immediately without the garden wall and resembles the alluvium of the plain below. This light and dusty soil is heaped into ridges inclosing small areas for the purpose of irrigation, made possible by the presence of a small stream which enters the inclosure and supplies a small reservoir surrounded by tall canes. The overflow from this tank never goes very far, but is quickly absorbed by the thirsty ground; only when the gate is opened does the stream suffice to reach the most remote limits of the vineyard.

Following one of the rudely paved walks leading from the casa, one descends a gentle slope to a high-walled inclosure. A low gate, swinging on rusty hinges, admits to a wide hall extending to right and left, from which, opposite the entrance, steps lead down to a large bath. Through an arched portal at the foot of the steps one may pass out into 5 or 6 feet of water in a pool about 30 by 50 feet. A ledge 2 or 3 feet wide surrounds

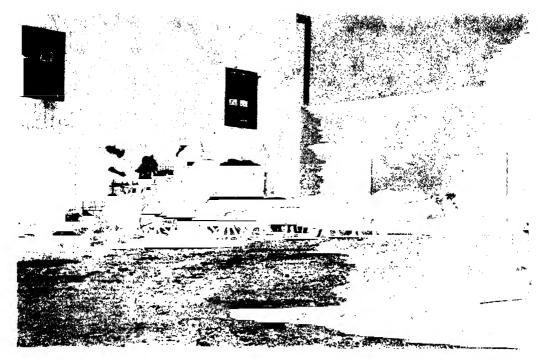


Photo by J. E. Kirkwood

UNIOADING FIBER AT THE HEADQUARTERS OF THE HACIENDA DE CEDROS

Peons work for months at distant stations on the property and are paid per kilogram when
the fiber is delivered

the basin and connects with the broader landing on the side of the entrance. This bath is supplied by the same spring that passes beneath the wine cellar, the waters of which are led thither by a tunnel 100 yards long under 15 feet of earth and stone. This bath is cold, but another at some distance is warm and was a favorite resort. It also is inclosed by high walls and barred doors.

The village of Cedros holds about 500 souls and the casa grande is the center of its life. The "Large House" has always been the center of hacienda life. The establishment of the old haciendas upon the lines of a feudal barony was doubtless agreeable to the owners; but there were then, and also until recent years, conditions throughout the country which not only justified such a scheme of social organization, but made it a practical necessity. Unsettled and lawless as the land then was, infested by Indians and marauding bands of thieves, possession of the land was not only nine points in favor of the contestant, but the whole of

the argument. It then behooved the proprietor of an estate to fortify himself and to secure his property against all who would wrest it from him.

MASTER AND SERVANT

To such, therefore, as he could offer protection and employment he came to be in the nature of a master, and such as enjoyed his favor and protection became identified with the property and attached to it as vassals. The law prohibiting a peon's leaving an estate while in debt to it practically made him a fixture, and this law, being still in force, makes his condition today little different from that of former times, though peonage has nominally been abolished.

Wages of the Mexican peon are about 37 cents a day, Mexican currency. Such wages practically insure his perpetual dependency and make it difficult or impossible for him ever to become independent of the property upon which he was born. This condition, which may be regarded as typical of a large section, if not of the

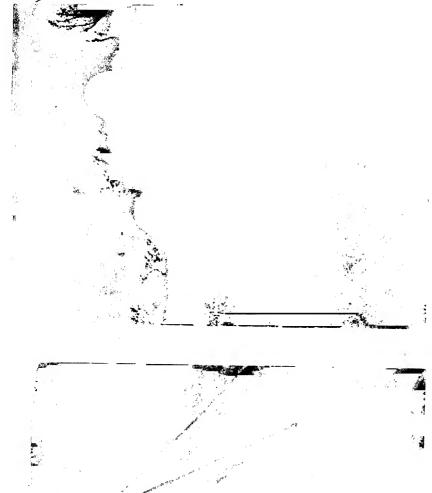


Photo by J. E. Kirkwood

STRIPPING PALMA FIBER

The central leaves of the cluster are soft and useless; such are rejected, as seen in the foreground. "The fiber is stripped from the leaves of the plants by hand. The leaves are long and narrow and the fibers extend from end to end. A workman seizes a leaf, lays it across a block of wood under a heavy dull knife, which is pressed upon the

Photo by J. E. Kirkwood A GROUP OF LARGE CACTI ON THE HACIENDA DE CEDROS, 4 TO 5 FEET IN HEIGHT.

leaf as it is drawn through, and thus parts the fiber from the pulpy tissue. The leaves of the palma must be softened by steaming before they are stripped, but those of the *lechuguilla* may be cleaned at once (see lext, page 579).

whole of the country, is not compensated for by the fact that his wants are few and easily satisfied.

The peon is not ambitious; he is apathetic. But he has known no better life, and the lack of incentive to effort renders his mental and moral elevation a matter of greater difficulty than it otherwise might be. Taking into account the generations of servitude to which he has been subject, it is not strange that he evinces no regard for the morrow, except as a time to which all disagreeable things should be postponed, and no concern for any interests other than those of the immediate present.

THE CHILDISH PEON

He is essentially a child and is to be treated as such. His salvation is not in higher wages, which would soon be squandered, leaving him in worse condition than before, but first in education of the right sort, which will give him an outlook upon life and an incentive to effort. At the time when the writer knew Cedros it had just passed from the control of its Mexican owners into the hands of an American company, whose interest in the property was mainly in the exploitation of guayule, a small rubber-bearing tree of the desert. With the advent of the new management an effort was made to improve the condition of the peon and the quality of his service by the payment of higher wages, with the result that he worked less than he did before and no more often than was necessary to eke out a subsistence.

The people of the hacienda have little opportunity for education and rarely receive any instruction worthy of the name. A little teaching of the merest rudiments by instructors whose own education is exceedingly meager, with a dearth of books and a dark hovel for a schoolroom, is a fair representation of their educational opportunity; yet many of these people have large capacity for education and are eager to learn.

That the interests of the country would be better served if they were given reasonable educational opportunity seems obvious; but the status of the peon, historic and economic, militates against his receiving the consideration which he deserves

Mixture of Spanish and Indian blood is common among the peon population. Many of these people are clean, intelligent, and industrious, but the reverse is more frequently true. In the small community at Cedros, where both extremes and many intermediate conditions obtain, it is pleasant to remember an acquaintance with a family of the better sort.

It would be difficult to find more genuine courtesy and refined taste than was habitually shown by the members of this household. They were comparatively uneducated, but their spirit and manners were apparently actuated by an innate sense of delicacy and propriety. And we found others of the same sort whose manners would put to shame many boasting higher education and culture.

DIVISION MANAGERS

For business management the large hacienda is divided into fractions (this hacienda into seven fracciones), over each of which an officer, caporal, presides, who administers his district and is responsible to the owner, or representative of the owner, the administrador. The peon labor is in charge of a mayordomo, who assigns the men their tasks, supervises their work, and gives account to his chief.

It is hardly necessary to say that the operations of a hacienda in their character and extent are controlled very largely by the natural resources of the region occupied. Mining, farming, and stock-raising are the principal enterprises of the haciendas on the plateau, while exploitation of native plants yielding fiber, rubber, liquors, etc., are also operations of importance in many places.

In most instances where the management of such business is in the hands of the Mexican and has not passed under the control of more progressive people, the methods employed are of the crudest sort. One observing their farming in the outlying districts might imagine himself living in the days of the Pharaohs. The field is plowed with a crooked stick drawn by oxen, with the yoke tied to the horns. Grain is cut with sickle and

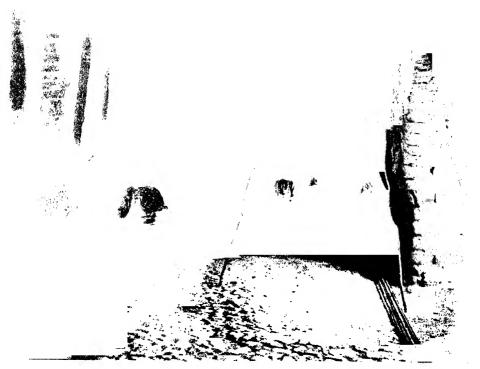


Photo by J. E. Kirkwood

ONE END OF THE ROPE-WALK AT CEDROS (SEE PAGE 584)

In this first picture the boys are in position to manipulate the spinning apparatus. One is winding a bobbin. In the picture on page 575 the spinners, the rope yarns, and the loom are seen.

threshed by the hoofs of cattle, and corn is planted and shelled by hand. Rough and heavy home-made carts or the backs of men or burros are the most common modes of conveyance. The people seem to have no appreciation of improved farming implements. Often when improved implements are provided the laborers they discard them for more primitive methods.

The principal agricultural crop of the region is corn, but small grains, beans, squashes, and a few vegetables are also raised. Corn is the staple cereal for the poorer classes, furnishing material for tortillas and tamales; beans, chilis, and onions are easily grown and form some of the chief elements of the Mexican's diet.

MEXICAN CROPS

All of these crops are matured in the short season of the summer rains. July

and August can usually be depended upon for heavy showers at not distant intervals, and the drainage of the uncultivated ground is so managed that the run-off is directed over the fields, which thus receive not only the rain which falls upon them, but also that which falls upon a considerable area of the adjacent land. Plowing and seeding are done mostly in July, and October is the month of harvest.

The fruits produced in this region from the few trees growing in the betterwatered situations are the fig, pomegranate, avocado, grape, quince, and some inferior apples. One of the most common of the fruits of the country is the tuna, the fruits of the cactus of the prickly-pear kind, which grows to immense size and is a feature of almost every well-ordered garden and door-yard. There are a number of varieties of this fruit, most of them being larger than a hen's egg and



THE OTHER END OF THE ROPE-WALK

Photo by J. E. Kirkwood

"By means of a string passed over the wheels a boy keeps them in rapid revolution, while the spinner, carrying a bundle of fiber suspended at his waist, backs away toward the other end of the walk, feeding out the fiber slowly to form the rope yarn, a hundred feet or more in length. These yarns may then be twisted into ropes or fed into a rude wooden loom, operated by foot power, and woven into matting" (see text, page 584).

purple, red, or yellow in color. This fruit is largely a food of the poorer class of people, who use it fresh or preserved. Pecans are largely planted for their nuts and for the ample shade which their crowns afford.

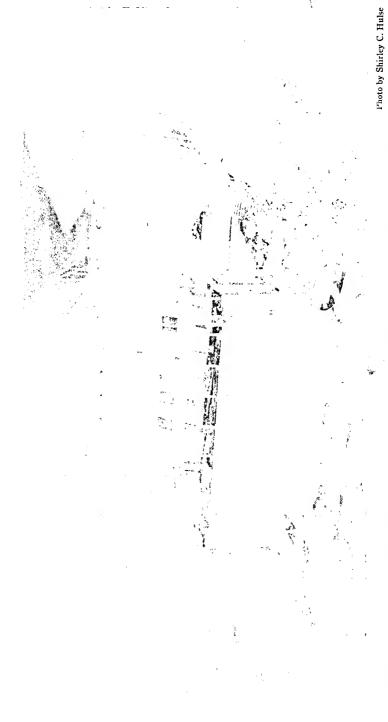
THESE DESERTS SUPPORT VAST HERDS OF CATTLE

On the haciendas of the plateau the business of stock-raising is one of the most important and one to which the natural features of the country are best adapted. Though semi-desert in its character and with few springs and fewer streams, yet large herds of animals are raised on these vast plains.

At the time of the transfer of Cedros to its American owners it was estimated that the hacienda supported a half million head of live stock of various kinds. So

scant is the growth of grass in this land, however, that one is not impressed with it at sight as a stock range, but the stock get much of their forage from leaves and twigs of many species of woody plants in which the place abounds.

The problem of water supply is a serious one and is solved by the construction of numerous represas, or tanques, in which the drainage of the surrounding slopes is collected in the rainy season. These tanks are often many acres in extent and the water fills the shallow basin to the depth of 15 or 20 feet. A tank is formed by throwing a dam of earth or masonry across a valley at a convenient point, thus forming a reservoir into which are gathered the waters drained from a considerable area. In this way the herdsman makes good the lack of streams, for there is usually water retained in these



This huge project was forced to shut down in September. 1913. because of interrupted railroad communication and the impossibility of bringing supplies to the work. It had for a long time previously been the one construction work of size going forward in Mexico. This project will ultimately deliver electric power to the rich mining district of Parral, 50 miles to the south, MAIN DAM OF THE MEXICAN NORTHERN POWER COMPANY PROJECT AT BOQUILLA, NEAR SANTA ROSALIA, CHIHUAHUA

tanks throughout the dry season. If the tanks are located in the vicinity of steep drainage areas, they are likely to become silted up in a few years, thus necessitating an increase in the height of the dam or the selection of another site for a new one.

MINING PROPERTIES OF GREAT VALUE

Many of the haciendas are mining properties of great value. Copper, silver, and lead are the most abundant products. The mountains of the region are richly mineralized, and here and there on a high crest may be seen the outward evidence of the more or less extensive operations going on within the mountain. Some of these mines were worked by the early Spaniards and are still productive. the Naranjera property, at San Pedro Ocampo, the hill is honeycombed with pits and galleries from which in the early days ore was taken without science or system, except as the richness of the rock indicated the most profitable direction for the expenditure of effort. The work is now carried on under modern methods.

In the village of Cedros stands an old smelter, typical of the methods formerly in use. It was built of adobe and the fuel used was charcoal, probably produced at Mazapil. Huge piles containing a half million tons of slag are close at hand, and contain, it is said, precious metals abundantly sufficient for a resmelting, so crude was the process then employed. The plant was also equipped for crushing the ore, as indicated by the presence of two large overshot wheels, supplied with water from the hillsides by means of a high aqueduct, the arches of which are still standing.

The ore was brought for miles on the backs of burros or in carts from the 150 mines formerly in operation on the hacienda. As no mines of any consequence, however, occur within 10 miles of this site the amount of labor involved in these operations was enormous.

On the opposite side of the village is a large inclosure, with extensive buildings, concerned with mining operations of a different sort. Though long in disuse, some of the old arrastras, or rude mills of stone for crushing ore, still stand, and the paved court and the old furnaces bear witness to the extraction of silver in former days.

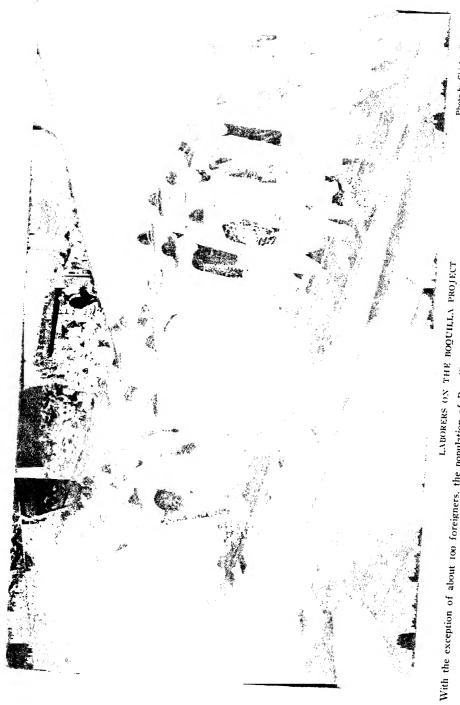
EXTRACTING SILVER

An early traveler in Mexico cites the method then in use as involving first a thorough crushing of the ore by means of a heavy rolling stone, water being added in the meantime to form a thick paste. The paste was finally removed to an open square and deposited in circular beds about 10 feet in diameter. Salt or salt earth was then sprinkled over it, with a little pulverized pine bark or manure, and it was then thoroughly mixed by treading with horses or mules and allowed to stand three or four days. then received a mixture of magistral and quicksilver in considerable quantities, was trampled as before, left for a day and trampled again, and so on from day to day until the metals were fully amal-The mass was then transgamated. ferred to an elevated vat and the water drained off. Water was afterward added in large quantities and the whole mixed until the amalgam settled, when it was filtered through canvas and made into triangular bricks, which were set up with spaces between under a copper bell. Charcoal was then heaped upon the bell and ignited. After 12 hours of heating the mercury and silver were separated and the latter removed pure.

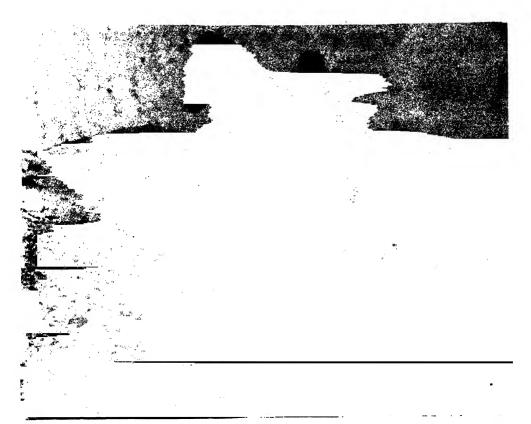
FIBER PLANTS

But Cedros is no longer a mining hacienda. Other interests have superseded, and in late years the Campania Ganadera y Textil de Cedros represented stock and fiber as its chief sources of revenue. Fiber-bearing plants are one of the natural resources of the country, and the amount of fiber shipped from this hacienda alone amounts to over 90 tons annually.

Two kinds of fiber are produced in large quantities. One is from the leaves of a yucca-like tree commonly called by the natives palma, and the other goes usually by the name lechuguilla, and is derived from a small relative of the century plant, exceedingly abundant throughout the northern half of the Re-



With the exception of about 100 foreigners, the population of Boguilla was entirely Mexican, and the Mexican village numbered at times 7,000



AN AMERICAN GIRL IN MEXICO

Photo by Shirley C. Hulse

Peggy loved to jump "Rosey" over anything in the way of ditches or arroyos that he could be made to tackle

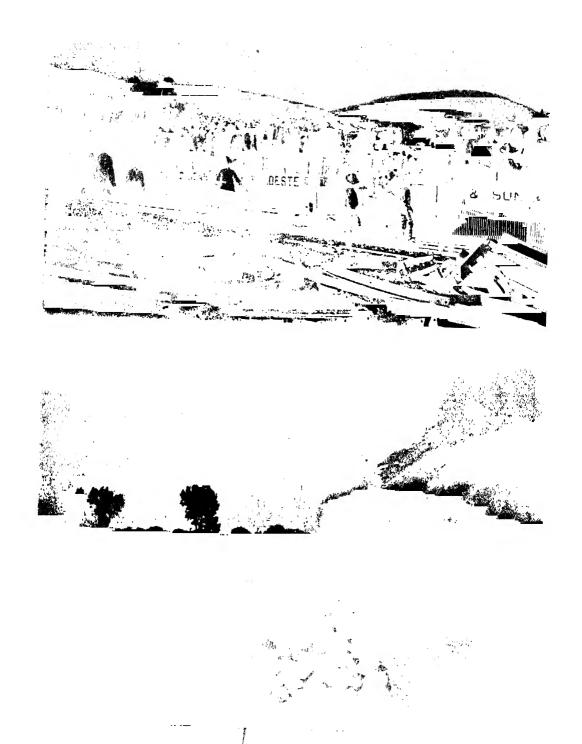
public. The fiber is soft, pliable, and strong and is much used for cordage, matting, bags, etc. Some of the fiber is manufactured locally, but the most of it finds a market in New York and other foreign ports.

The fiber is stripped from the leaves of the plants by hand. The leaves are long and narrow and the fibers extend from end to end. A workman seizes a leaf, lays it across a block of wood under a heavy dull knife, which is pressed upon the leaf as it is drawn through, and thus parts the fiber from the pulpy tissue. The leaves of the palma must be softened by steaming before they are stripped, but those of the lechuguilla may be cleaned It is a common sight to see at once. great cartloads of this pale yellow fiber drawn into Cedros, where it is weighed out and the men paid according to the amount produced.

The articles made from these fibers are strong, firm, and compact, though somewhat coarse and rough. They are such articles as one sees everywhere in Mexico—articles very well adapted to the purpose for which they are intended. A kind of heavy matting, much used for floor covering in offices and similar places, serves its purpose well. Besides these articles, the fiber is used in the manufacture of various kinds of cordage, and much of it finds its way into brushes, of which a great variety may be found, both of home and of foreign manufacture.

THE ROPE-WALK

In one of the long buildings at Cedros is an old rope-walk. Here a part of the fiber of local extraction is manufactured. The machinery consists of three wooden posts, in which are set small wooden



The company had, from Boquilla to the neighborhood of Santa Rosalia, a private rail-road, and, owing to the conditions, it was impossible to restrict the riding of the people on this line. The Mexican peon rides on a railroad, should the opportunity offer, in much the same spirit that a six-year-old child rides in an elevator, and at times the company's traffic was seriously interfered with by the number of the properture of the properture

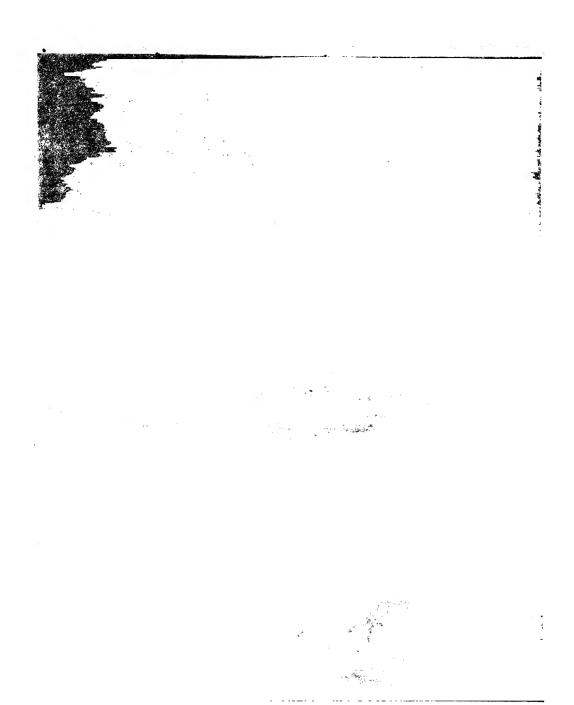


Photo by Shirley C. Hulse

AN OLD MEXICAN RANCH AND FORT NEAR SANTA ROSALIA, CHIHUAHUA

This ranch, which has lately been submerged by the waters of Lake Conchos above the dam at Boquilla, is said to have had a very stirring history as an Indian fort. The patriarch of this ranch had never heard of a camera nor a photograph and he was utterly at a loss when permission was asked to take his picture. At first he was made very nervous by the presence of the camera, but after everything had been explained to his satisfaction he was quite willing to pose for his picture, and his final comment on photography was, "Who could do such wonderful things but God or an American."



CHARACTERISTIC SCENE IN THE MEXICAN STATE OF CHIHUAHUA, WHICH IS DIRECTLY SOUTH OF EL PASO, TEXAS

Goats are raised in very great numbers all through the barren parts of Chihnahua, and they thrive where nothing else, except possibly a burro, could pick up a living. They are valued for their milk and for their skins, which go by thousands into glove leather. The holes along the foot of the bank have been made by the goats licking at a salty stratum in the earth.



Photo by Shirley C. Hulse

THIS MENICAN GIRL WAS FOR SEVERAL YEARS NURSE AND DOCTOR'S ASSISTANT AT BOQUILLA

She attracted the doctor's attention by her interest in the affairs of the hospital, and, from an ignorant, untrained beginning, she came in time to take full charge of the doctor's work during his illness or absence. She has upon occasion successfully performed surgical operations, herself giving the anesthetic, with no help but that of a mozo. She was absolutely cold-blooded and unfeeling in her handling of patients, perhaps to their ultimate benefit, and she has been suspected of slyly working off personal grudges upon the persons of certain sufferers on the operating table. This was, however, merely in a spirit of mischief and consisted only in getting an occasional harmless yelp and wriggle from the victim. In common with many of the Mexicans, she was exceedingly clever with her pencil, and she copied from American fashion-plates and made for herself clothes which would have done her credit on Fifth avenue itself. Also, she was the personification of meekness and industry, and it is to be hoped that she is a fair illustration of Mexican possibilities, granted the opportunity to learn and to advance

wheels revolving at right angles to the direction of the walk. The posts are set at one end of the walk, with the axle of one of the wheels in each post projecting through in the direction of the walk, so that a wisp of the fiber may be attached to it.

By means of a string passed over the wheels a boy keeps them in rapid revolution, while the spinner, carrying a bundle of fiber suspended at his waist, backs away toward the other end of the walk, feeding out the fiber slowly to form the rope yarn, a hundred feet or more in length. These yarns may then be twisted into ropes or fed into a rude wooden loom, operated by foot power, and woven into matting.

There grows extensively over the tableland a small desert tree, less than 4 feet in height, with silvery, grayish leaves. It grows often as the dominant plant over considerable areas of the calcareous foothills, where it gives an aspect to the vegetation similar to that of the sage-brush areas of our western plains. This plant is widely known as the *guayule*, and its product, a kind of rubber, has been an item of large commercial interest in central Mexico during the last decade.

Although it was known long ago that the plant produced rubber, its profitable extraction has been a matter of only recent years, and now on many of the haciendas the cutting of *guayule* is a thriving and remunerative business. The plant is generally uprooted, regardless of conservation principles, bound into bales, and shipped to factories in the cities. About

10 per cent of the dry weight of the tree is gum, which is separated from the tissue by grinding and extraction by solvents or by mechanical agencies.

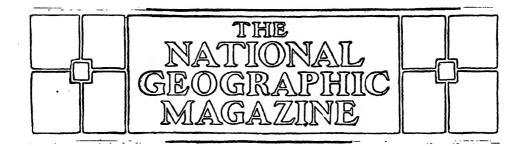
THE DAYS OF THE HACIENDA ARE NUMBERED

Various other activities of greater or less magnitude and importance are features of the hacienda life, much as they have been since the first settlement of the country. Where the railroads have penetrated and foreign capital has entered, they feel to some extent the influence of the world's progress and the march of events. At the best, however, they are isolated and provincial, living in the distant past, preferring old customs, manners, and dress, and tenacious of indolent habits, the rich and the poor alike.

The days of the old haciendas are numbered. Such institutions cannot long resist the pressure of the times. Capital is insistent for opportunity where there is profitable investment. Colonization enterprises in different parts of the country have already secured large areas and divided them into small tracts. Revolutions can only temporarily delay such development.

The best leaders of the Mexican people are realizing that one of the great needs of the nation is the free use of the land and the building of homes. Whatever the outcome of the present strife, there awaits a period of reconstruction in which the disposition of the hacienda must have a large share.

Mr. Robert E. Coker's article, "Wealth of a Rainless Coast," noted on pages 514 and 515, was originally scheduled for this month's issue, and the pictures given to the engraver some months ago, to be printed with the bird series in colors. In view of the great demand for information about Mexico, it has been deemed expedient to temporarily withhold Mr. Coker's interesting article to admit the Mexican material.



THE HOME OF A FORGOTTEN RACE

Mysterious Chichen Itza, in Yucatan, Mexico

By Edward H. Thompson

FORMERLY U. S. CONSUL AT MÉRIDA, YUCATAN

HE ruined group of Chichen Itza, on the Peninsula of Yucatan, Mexico, covers a space of fully 3 square miles. Over all this wide territory are scattered carved and squared stones in countless thousands, and fallen columns by the hundreds, while the formless remains and outlined walls of huge structures fallen into ruin are seen on every side.

Seven massive structures of carved stone and adamantine mortar still tower erect and almost habitable. Their facades, though gray and haggard with age and seamed by time, sustain the claim that Chichen Itza, in the Americas, is one of the world's greatest monuments of antiquity.

The heart of most of the cities of antiquity was a castle or temple; in this great American monument the heart was a castle and a temple—both in one.

As this is a popular descriptive article rather than a technical one, I shall try to restrain my always present desire and inject only enough figures to give adequate conceptions of size and distance.

A terrace as broad and level as a plain is raised 10 feet or more above the surrounding surface, built up with rubble and finished with a lime cement—hard, white, and durable. On this man-made plain was built, among other structures, a pyramid of nine terraces (see page

586), each faced with inlaid paneled stonework and well finished.

On each of the four inclined faces of this pyramid a stairway was built 111 feet long and 28.7 feet wide, with 104 steps rising from the base-level up to the crowning platform.

Each of the four angles of the pyramid is formed by the undulating body of a great stone serpent. Descending from the crowning platform, each undulation of the body marks a gradient, a terrace plane, while on each side of the northern stairway a serpent head, with wide-open jaws, carved from a single mass of limestone, rests on the plane beneath. A strong man cannot hope to lift the smallest stone that goes into the making of this serpent body.

THE CASTLE TEMPLE

All this is simply of the base, the preparation for and the leading up to the building proper, the Castle Temple (see page 586). This temple is not large, measured by the standards of the present day, or even by that of those ancient builders. Like the heart of the human body, it was not large but important.

Built on the level platform that crowned the pyramid, it is itself only 43 feet by 29 feet, with a narrow level space around it on the platform's outer edge barely wide enough for two to walk abreast in safety.

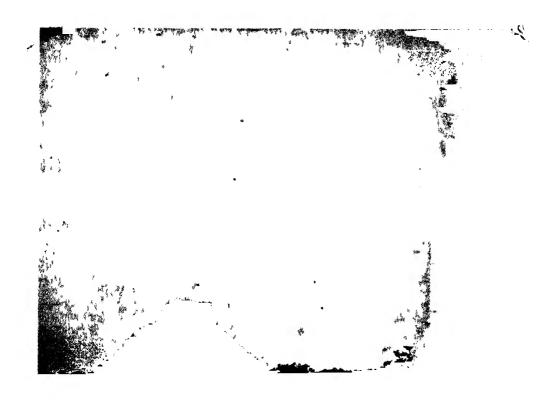


Photo by I dward H Thompson

THE GREAT PARAMID TEMPLE OF CHICHEN ITZA, IN YUCATAN, MEXICO

"On the roof are ornaments of carved stone cut in curious angles and placed like battle ments. These probably served as shelters to the fighting men and protection to the priestly watchers of the stars and planets as they traced the celestial orbits and read the omens this revealed" (see text, pages 585 and 587) On the north, facing a few degrees east of north, is the Ceremonial Stairway, with its two great serpent heads leading up the pyramid to the entrance of the sanctuary.

Thick stone pillars, fashioned always in the conventionalized serpent form, sustain the carved and paneled façade above the entrance to the outer corridor and inner chamber, the sanctuary of the temple. In the semi-gloom of this sanctuary are two square pillars of stone, each supporting massive twin beams of thick sapote wood richly carved. These in their turn help to support the strange triple-vaulted roof of the chamber (see page 588). Sapote wood, like the East Indian teak, is as strong and almost as durable as stone.

Wooden beams, stone pillars, and entrance posts are all carved in low relief (see page 589). Symbols and human figures, some in mask and bearded, and all clothed in ornate regalia, with strange weapons and the flowing plumes of the quetzal, cover their paneled surfaces.

The symbol of the feathered serpent—the body of the rattlesnake, covered with the plumage of the quetzal bird—was to this old civilization what the Cross was to the Christian and the Crescent to the Saracen.

Under this symbol the culture hero Kuk-ul-can (Feathered Serpent) of Yucatan, Quetzacoatl of the Aztecs and earlier people, was first reverenced, then deified and worshipped.

Most of the carvings on stone surface were painted, but the wooden lintels, carved or plain, were apparently dull finished in their own natural color—a rich red brown.

On the south, east, and west a single high-vaulted but narrow chamber was formed [-shaped, with sapote lintels and carved doorways facing each of the stairways

Large serpent masks, each flanked by sunken paneled squares, are the only ornaments of these three façades, and, except that on the western façade, are placed directly over the entrances. The mask of this western façade is several feet to the south of the entrance.

This was not a random work, neither

did the conformation of the structure make this lack of symmetry a necessary fault.

Is it true that the ancient builders of the East were wont to leave one stone missing or one carving misplaced in an otherwise perfect work because only the Supreme One should produce perfection?

On the roof are ornaments of carved stone cut in curious angles and placed like battlements. These probably served as shelters to the fighting men and protection to the priestly watchers of the stars and planets as they traced the celestial orbits and read the omens thus revealed.

THE HOUR OF SUNRISE

The writer stood upon the roof of this temple one morning last December just as the first rays of the sun reddened the distant horizon. The morning stillness was profound. The noises of the night had ceased and those of the day were not yet begun. All the sky above and the earth below seemed to be breathlessly waiting for something—just waiting. Then the great round sun came up fianting splendidly, and instantly the whole world sang and hummed. The birds in the trees and the insects on the ground sang in a grand Te Deum.

Nature herself taught primal man to be a sun-worshipper, and man in his heart of hearts still follows the ancient teachings.

A gentle breeze sprang up, and then he seemed to be upon a sea-bound rocky promontory, high above all things. The calm sea surface stretched away to where the sky-line met it, and there they fused into an opalescent something, seemingly born of the union of a rainbow with the white sea-foam.

The sun rose higher and the sea of mist dissolved into nothingness. In its place was an ocean of verdure, with a foam of bright blue flowers, the bloom of the jungle morning glory. As he descended the steps worn by the sandal tread of a thousand years, he thought: "Can this world show a more beautiful sight?"

From the northern edge of the level terrace at the base of the temple pyra-

Photo by Edward H. Thompson

.....

IN THE SEMI-GLOOM OF THIS SANCTUARY ARE TWO SQUARE PILLARS OF STONE, EACH SUPPORTING MASSIVE TWIN BEAMS OF THICK SAPOTE WOOD, RICHLY CARVED

Sapote wood, like the East Indian teak, is almost as strong and durable as stone. Note the warrior with his elaborate head-dress carved on the column (see page 587)

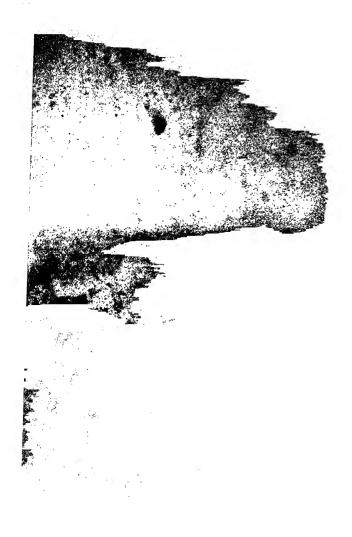


Photo by Edward H. Thompson

WOODEN BEAMS AND ENTRANCE POSTS ARE ALL CARVED IN LOW RELIEF

"Wooden beams, stone pillars, and entrance posts are all carved in low relief. Symbols and human figures, some in mask and bearded, and all clothed in ornate regalia, with strange weapons and the flowing plumes of the quetzal, cover their paneled surfaces" (see page 587).

mid a raised causeway, 25 feet wide and macadamized, extends northward 300 yards or more to the Sacred Well.

THE SACRED WELL INTO WHICH PRISON-ERS AND MAIDENS WERE THROWN

This was the Sacred Way, and in times of pestilence and drought solemn processions of priests, devotees with offerings, and victims for the sacrifice wound between the snake-head columns down the long, steep stairway of the temple and along the Sacred Way to the dreadful Sacred Well (see page 591). The weird music of the flute and the shrill notes of the whistle mingled with the droning boom of the sacred drum as the priests, the devotees with their offerings, and the nobles grouped themselves on the brink of the well.

Then from the platform beside the shrine the offerings from far and near were tossed in, and finally the prisoners of war and beautiful maidens, drugged with the sacred ambrosia Balche, were thrown into the jade-colored waters as expiatory offering to an offended deity.

Could this deep old limestone waterpit, the Sacred Well, be given a tongue and made to tell what it had seen, what world romance could equal it!

Several hundred feet to the west of the Castle Temple, and on the same terrace with it, rest two great parallel moles of solid masonry (see page 592), each 275 feet long, 34 feet wide, and 25 feet wat the apex of the roof, the overweight

Between these moles is the Ceremonial Court. This level cemented space was probably the theater for the performance of certain rites and games of a ceremonial character, like the Aztec game dedicated to Tlaloc.

This belief is borne out by the fact that at a distance of 6 feet from the level upper surface of the mole two great rings of stone were firmly fixed by means of tongues into the perpendicular wall surface directly opposite each other.

One of these rings had either fallen out of its place by its own weight, or more probably was dug out by native honey seekers, and now lies prostrate. but whole, on the ground beneath. The other yet stands out holdly from the

sheer wall surface, and the entwined serpents carved on its annular faces are still clearly visible.

To the north and south of these great moles are the half-ruined remains of two small temple structures (see page 594). Shrine-like, they seem to guard the entrance to the Ceremonial Court; but they themselves, their carved walls and columns time worn and beaten, are fully exposed to the wear of the elements.

THE TEMPLE OF THE TIGERS

On the southern end of the eastern mole rests an edifice, like a casket holding jewels, that in time, as the fact becomes known, will be in itself the object of distant pilgrimages.

It is known as the Temple of the Tigers (see page 595) from the zone band of handsomely designed, artistically executed jaguars that, alternating with shields, ornaments the southern face.

Of course, it is understood that the term "tiger" is a misnomer as applied to the great Felidæ in America; the jaguar and not the tiger is meant. The term "tigre," meaning tiger, was probably first carelessly given by Spanish adventurers to the jaguar from Asia, and the name was thus wrongly perpetuated in Anierica.

The entire front of the Temple of the Tigers has disappeared. Fractured and wedged apart by the growing tree roots of the richly carved façade toppled it over into the space beneath, where it still lies in a formless mass.

Two large serpent columns, with open jaws and bulbous teeth, are still in place. These once helped to sustain the fallen façade, and probably served as the massive fulcrum that tossed the mass of stone and lime free from the platform in front down on the level floor of the Ceremonial Court. These, like all the other serpent columns, are carved in the conventionalized crotalid shape and covered with the conventional quetzal plumes.

The square end pilasters of the outer entrance to the inner chamber are entirely covered with sculptures in low relief. Like those upon the pilasters and columns of the Castle Temple, the prin-

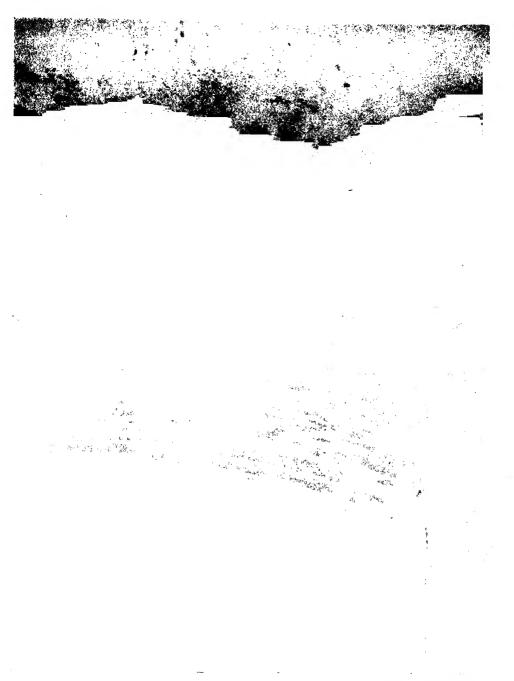


Photo by Edward H. Thompson

THE SACRED WELL INTO WHICH PRISONERS OF WAR AND BEAUTIFUL MAIDENS WERE THROWN

Could this old limestone water-pit, the sacred well, be given a tongue and made to tell what it has seen, what world romance could equal it!



Photo by Edward H. Thompson "This level, cemented space was probably the theater for the performance of certain rites and games of a ceremonial character. like the Aztec game dedicated to Tlaloc" (see text, page 590) THE GREAT PARALLEL MOLES OF SOLID MASONRY WHICH FLANK THE CEREMONIAL COURT

cipal motive on each panel is a human figure elaborately costumed and brilliantly painted.

MAYAN MURAL PAINTINGS

The wall surface of both chambers bear traces of having been once covered with mural paintings. Those on the walls of the outer chamber have become entirely obliterated by the erosive action of the elements. Those on the walls of the inner chamber are in part obliterated by the excreta of bats, and still more by the vandal hand of man.

Enough yet remains to make this little chamber the repository of the best-preserved examples of the mural paintings of this ancient Maya race at present known.

The best-preserved portion represents a battle scene. The attacking party, with atlatls, spears, and shields, are seemingly assaulting a city or some large center. Above the battlefield can be seen tier upon tier of houses, and amid them are women in agonized postures, looking down upon the fighting warriors.

To one side is the symbolical figure of Kuk-ul-can, with lightning-like yellow flames issuing from his mouth, the sign of defiance and also of war. Many other scenes and portions of figures are depicted, but the battle scene is the clearest of them all at present. The figures are done in a clear, easy style, vigorous and true.

Belonging to this same temple, but on a lower level and built against the eastern wall, is a chamber 22 feet long by 10 feet wide and 15 feet high.

The front of this chamber also is destroyed, and in practically the same way as that of the upper chamber. A portion of the end walls and a large part of the rear still remain upright (see page 596), and the superb wall sculptures they hold upon their surface are fortunately still left for study and comparison.

Clear-cut features, well-worked details, artistically executed and well carried out, show the skill and spirit of these ancient artists. The carvings clearly represent the performance of some religious rite or ceremonial dance. Entwined about the series of masked and

conventional figures are the serpent symbol, that of the sun and apparently that of rain and water.

Description is nearly useless in such cases as this; only photographs or drawings can adequately represent the work.

The figures were originally painted in the conventional colors, with the everpresent deep red background.

Portions of the two richly carved square pillars that once helped to sustain the fallen front, and between them a rigid conventionalized "tiger," seemingly a kind of ceremonial seat, complete all that is now visible of this chamber.

Half ruined as it is, the Temple of the Tigers is a treasure and a boon to students of the Maya civilization.

A MAYAN PRISON

South of the Temple of the Tigers lies the beautiful little structure known to the natives as the Chichen Chob, the Prison (see page 598), probably the most perfect existing unit of ancient Maya architecture. The pyramid supporting and the stairway leading up to it are almost intact, the angles and faces of the edifice itself almost perfect.

Within the chambers some of the wooden cross-beams are still in place, the mural paintings on the hard-finished walls are evident, although nearly effaced; but the long band of well-carved hieroglyphics that extend entirely across the wall opposite the doors is as perfect and delicately clear as if carved but yesterday.

To the southeast lies the Round Tower (see page 600), a strange structure, unique in plan and outline. This edifice rises like a turret, 40 feet and of equal diameter, from near the center of a terrace, 20 feet high, 220 feet long by 150 feet wide.

HUMBOLDT'S SURPRISE

Its purpose is at present unknown; but from its construction, annular chambers, winding stairway, and the position of its outlooks and outlets I believe it to have been an observatory, an edifice devoted to the study of the celestial bodies. It is known that the ancient American calendar system was so accurately developed



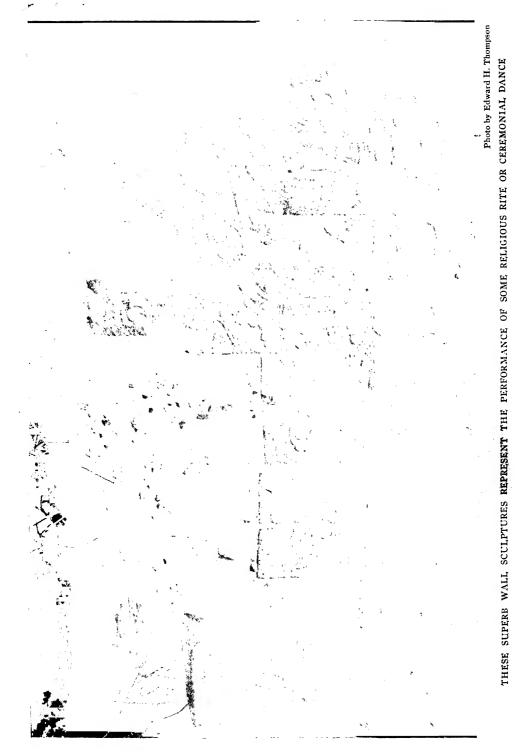
ONE OF THE TWO SMALL TEMPLES WHICH SEEM TO GUARD THE ENTRANCE TO THE CEREMONIAL COURT (SEE PAGE 590)



Photo by Edward H. Thompson

THE TEMPLE OF THE TIGERS

The band of handsomely carved jaguars, alternating with shields, can be discerned near the top of the building (see page 590). "Half ruined as it is, the Temple of the Tigers is a treasure and a boon to students of the Maya civilization" (see text, page 593).



that Alexander Von Humboldt was for a time incredulous of its native origin.

The learned ones, the wise men among these people, were astronomers, not mere star-gazers, and there are those among the Mayas at the present day that have a surprising native knowledge of the celestial geography, as well as of curious properties of certain roots and herbs on the earth beneath.

The present conical form of this edifice, the shape of its chambers, and above all the peculiar inner stairway winding around a solid center, have caused the natives to call it, in their vernacular, "The House of the Snail," and this name in its Spanish dress clings to it now. As the Caracol (Snail) it is best known to the people of the region, and under this name it is shown to the curious and the visitors from afar.

THE "NUNNERY"

Nearly half a mile to the south of the Castle Temple rises the majestic pile of the "Nunnery" (see page 602). How far this name accurately indicates the original purpose of the edifice is not known; but we do know that among these ancient people a certain social organization existed, resembling in a modified form the societies of monks and nuns.

How much or how little of truth is in the name we may not know, but the edifice itself is probably the most ancient of all the structures now standing. old no one knows; but the fact is evident that the central portion of the structure was old and time worn before the pitted surface and dulled angles were buried in the plastic mass of the newer masonry. Then in time this, too, was hidden under the present walls, new and clear lined then, but now gray and seamed by time and the elements, and this is a land where the ice never forms, the frost never rises, and dryness is more evident than dampness or moisture.

The façades of these later portions of the great mass of stone and lime are wonderful examples of carved stonework and ancient American symbolism. I doubt if, taken as a whole, their equal exists. The photographic views show this in a measure, and only in a measure.

The true beauty of the carvings and the perfect proportions of the structure can never be fitly shown until the debris that now hides the base and destroys the true symmetry of the edifice is removed. This work should be done by competent direction under supervision of the government.

Two small one-storied edifices, in the nature of detached wings, are on the right and left of the building proper.

right and left of the building proper.

One, known as "La Iglesia" Church, is still quite perfect, and the symbolical figures encrusted on its richly worked facade have long been objects of study to the student and of curiosity to the profane.

The other is a still smaller structure of ordinary design and no apparent points of special interest.

A wide, steep stairway, with the very narrow steps and risers common to the work of sandal-wearing people, leads up to the important second story. This portion of the structure sets back from the face of the lower one, thus leaving an open level space of some 30 feet wide, broken in front half way by the stairway leading up to the third story.

The lateral northern face of this upper second story has two true entrances into perfect chambers and four large recesses in the front walls that are either blind doorways or once true entrances into chambers formerly existing in the original structure, but later filled up to make a solid foundation for a third story directly above. When this was done the doorways remained as simple niches, and over these a flying buttress (see page 603) was thrown as a stairway to the newer structure above. This is my hypothesis, subject to modifications that future investigations may make necessary.

The stone lintels over every entrance, existing or blind, built into this face of the end walls are covered with handsome, still legible glyphs. Clearly legible indeed, but as unreadable as a sealed book

Undeciphered and mysterious, they are the pleasure and despair of those who seek to solve the problems that they hold.

Photo by Edward H. Thompson THE PRISON OR CHICHEN CHOB, PROBABLY THE MOST PERFECT EXISTING UNIT OF ANCIENT MAYA ARCHITECTURE (SEE PAGE 593)

All the chambers within this second story of the edifice have within the wall spaces opposite the entrances various niches about the height of the entrances, but narrower. None, even the smaller chambers, have less than two, and the long, narrow middle chamber on the south face has five.

These may have been doorways, originally giving entrance into the primitive structure, closed when the central portion was made into a solid core; but various circumstances, among them being the presence and position of the recesses in the walls of the end chamber, cause me to throw aside this hypothesis. To me they have all the appearances of having been true niches.

THE RECORDS OF THIS ANCIENT PEOPLE WERE DESTROYED BY THE SPANIARDS

They give, in the mind of the student of these old structures, the appearance of having been repositories. Perhaps within these niches were stored the rolls of parchment, the folded books on deerskin and agave paper, the plans and records, and all the written lore of this city of the Maya wise men, the "Itzaes."

Who knows but their contents formed part of that funereal pyre of ancient Maya literature made by the zealot, Bishop de Landa, on the Mani common.

De Landa, seeing on these old rolls of deerskin and volumes of maguey paper signs that he could not read and symbols that he could not understand, concluded that they were cabalistic signs of a diabolical nature, and caused them, together with many other objects of inestimable value to science, to be destroyed by fire on the public square in the Pueblo de Mani.

At that time the old chroniclers tell us there were destroyed 5,000 idols of distinct forms and sizes, 13 altar stones, 22 stones, carved and of small sizes; 27 rolls of ancient hieroglyphics on deerskin, 197 vases of all sizes and patterns, and many other unrecorded objects.

An ancient Spanish chronicler states naïvely that the natives who witnessed the destruction by fire were much afflicted and made a great outcry of woe.

Is it to be wondered that they made a

great outcry of woe? They saw not only the sacred things calcining in the fervent heat, but also the written lore, accumulated knowledge of their race, going up in smoke and red cinders. Naturally the thinking ones among them "made great outcry."

Around the corners and on the unbroken portions of the smooth, hard finish in the recesses are traces of broad red, blue, and green bands forming the paneled outlines for the detail figures within. On the ceiling in places are still the fragmentary outlines of houses, trees, city walls, and nondescript animals.

On the inner walls of the eastern end chamber can be clearly seen the impress of the "red hand," another of the unsolved problems.

The third upper story is small and presents the idea of incompleteness, although its state of ruin prevents the last word being said until excavation and investigation have taken place under some competent person.

The last and least important of the seven structures yet standing is the so-called "House of the Dark Writings." The structure is a huge one-story edifice. Large forest trees grow over its flat roof, and were it not for its vertical wall faces of well-carved stone one could easily believe that he was treading the primeval forest floor.

The name, Akab tzib, House of the Dark Writing, was given to it by the natives because in the gloom of an inner chamber can be seen a lintel of stone, covered with glyphs and having on its under surface a seated figure in the act, apparently, of offering up some kind of burnt sacrifice.

This ends the list of the still existing structures; but the wonders to be seen prostrate and those hidden have not yet been mentioned.

We have not mentioned the sepulchers of the high priests, 90 feet beneath the crown of the pyramid, 50 feet in the solid rock; the rock carvings; jaguars carved on the ledge surface; the great natural well from whence this ancient city received its water supply; the caves, with their prehistoric defenses, stalactites, grottoes, and pools of clear, cool



THE ROUND TOWER WHICH WAS PROBABLY THE ASTRONOMICAL OBSERVATORY

"From its construction, annular chambers, winding stairway, and the portion of its outlooks and outlets, I believe it to have been an observa-(see text, pages 593 and 597) tory, an edifice devoted to the study of the celestial bodies. It is known the that Alexander Von Humboldt was for a time incredulous of its native s

water—these and many other things we have the desire to depict and describe, but time and space forbid.

WHEN WAS THIS CITY FOUNDED?

How old is this great city of stonebuilt temples and myriad carvings? For years—we have sought among its fallen columns and toppled walls for that which would tell us clearly of its age.

To a certain extent the search has not been in vain. We have found a tablet of stone covered with hieroglyphs, and among them are signs that fix a date, an epoch. Keen minds and trained are now at work on the tablet, and the time may not be far distant when we shall know whether it be 2,000 years old or less, as some students claim, or over 11,500 years, as claimed by Le Plongeon.

The margin between the two "guesses"

is certainly wide enough.

Meanwhile, like the Sphynx in the East, the gray, old human faces carved high on the massive walls gaze down unchangingly, unmindful of modern man and his futile guesses.

We have perhaps more information on the early history of this ancient group than we have of any other center of the

Maya civilization.

But as that keen scholar, the lamented Dr. Thompson, was fond of impressing upon his pupils, "Gentlemen, information may or may not be facts, and unless it be of proven facts is not knowledge." Even "information" concerning these ancient builders and their buildings is only too scanty, and actual proven facts still more so.

THE LEGEND OF CHICHEN ITZA

The earliest information concerning Chichen Itza is given in a curious document found by Don Juan Pio Perez, a Yucatan scholar and antiquarian, among the dusty old records and archives in the Town Hall of Mani.

The document commences thus: "Lai u tzolan katun lukci ti cab ti yotoch Nonoual"—I might continue on in this way for some time, but all might not understand the text as clearly as could be wished. In fact, the fear of a sudden rupture of relations between writer and

reader induces me to forego, and in place give a broad interpretation of the ancient writings in those parts where allusion is made to Chichen Itza.

Translated, the document commences thus, the brackets being my interpola-

"This is the series of epochs that elapsed from the time of their departure from the house of Nonoual in the land of Tulapan.

"Then took place the discovery of Bacalar. Sixty years they ruled in Baca-

lar, when they came here.

"During these years of their government of this province of Bacalar occurred the discovery of Chichen Itza. 120 years they ruled in Chichen Itza, when they left it and went to Champutun, where the Itzaes, holy men, had houses

"260 years reigned the Itzaes in Champutun, when they abandoned it and returned in search of their homes.

"For several epochs they lived in the woods and the caves, under the uninhabited hills.

"After forty years they returned to their homes (Chichen Itza) once more, and Champutun knew them no more.

"Two hundred years they reigned in Uxmal, Chichen Itza, Mayapan. The governor of Chichen Itza (Chac xib chac) was deposed because he murmured disrespectfully against Tunac-eel, the governor of Mayapan. Ninety years had elapsed, but the tenth of the 8th Ahau was the year in which he was overthrown."

The unknown native writer keeps on; but I will stop, as he mentions Chichen Itza no more.

Neither the name nor the history of its writer is known; but from the perfect command of both the native vernacular and the Spanish letters it would seem to have been the work of an educated native and written within a few decades after the conquest. This would not be strange, for many bright young natives, sons of the nobles and of the reigning families, were taken by the church or by high lay officials and educated in Spanish learning.

Thus Caspar Antonio Xiu, the lineal

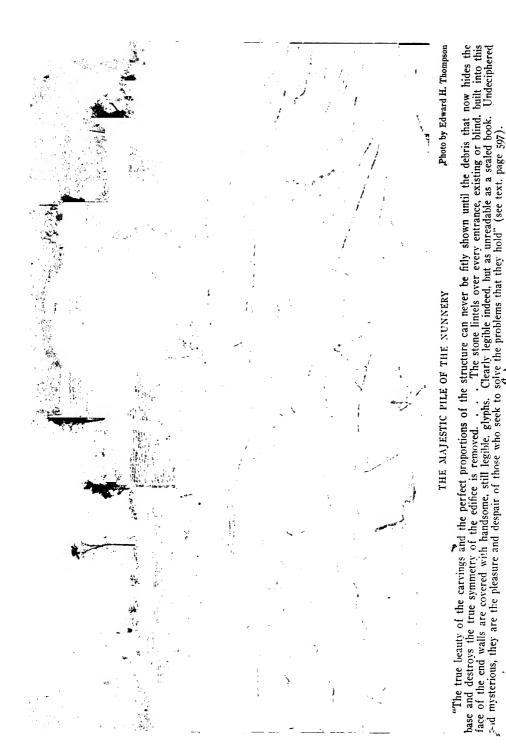




Photo by Edward H. Thompson

OVER THESE A FLYING BUTTRESS WAS THROWN AS STAIRWAY TO THE NEWER STRUC-TURE ABOVE (SEE PAGE 597)

descendant of the last king of Mayapan, was taken, baptized, and educated by Montejo, the conqueror of Yucatan and its first governor.

THE ANCIENT MAYAS HAD THEIR BARDS AND STORY-TELLERS

The ancient Mayas, like most other races, had their bards and story-tellers, who interwove into their songs and tales the history of their people.

Thus, I repeat, it is not strange if some educated native filled, like the gifted Tescucan Ixtlilxochitl, prince and writer, with the desire to perpetuate the fading history of his people, had recourse to the device of writing out, as his memory served, their early wanderings and ancient history, and then, with native subtlety, to hide the documents under those

longest filed away and in archives likely to be safe and undisturbed until times far later.

There is a legend of Chichen Itza that has seemingly more of the material of true history in its making than legends are usually thought to have. At all events, it is genuinely romantic and worth repeating.

THE LEGEND OF CANEK

Canek, the impetuous young ruler of Chichen Itza, was deeply in love with a beautiful maiden, daughter of the ruler of a distant province. No longer were his thoughts on the coming hunt of the jaguar; the wild boar passed grunting and unharmed, even unnoticed, as the young ruler sat musing on a fallen log. A fawn, chased by the hunters, became

* THE NATIONAL GEOGRAPHIC MAGAZINE

entangled in a snare close beside him as he sat motionless, happily musing. Seeing that its big, soft eyes were like those of the maiden he loved, he loosed its bonds and set it free.

In the midst of his amorous musings, as he sat in his chamber one day, a dust-covered runner came up to the palace entrance and rattled the sounding shells before the curtains for instant entrance on the ruler's service.

The news he brought drove the young

ruler to desperation.

The Batab of a neighboring province, and one far more powerful than he of Chichen Itza, had married the maiden that Canek was to take to wife.

For a while no raging jaguar robbed of his mate was more furious than young Canek; then of a sudden he grew quiet, cool, and seemingly calm.

So his warriors remembered to have seen him when they fought an old-time enemy, killed his fighting men, and defaced his temple, and they patiently waited.

The night came and with it a brooding norther. Darkness as black as the hate in the heart of Canek was all around the silent ranks of the swiftly moving warriors. The lightning flashes, as sharp and hot as the anger that flamed in the Canek's breast, played over the glinting points of crystal on the moving forest of lances as they neared the enemy's city.

The ever-burning flames on the top of the distant temple gleamed redly, and black smoke went heavenward in increasing volume as the priests burnt, great baskets of copal in honor of their

ruler's marriage.

Canek and his silent warriors came swiftly onward, melting into the darkness of the shadows, hiding from the lightning flash, leaping ahead like deer when chance offered. Revelry had taken the city with all that was in it and held it hard and fast. Even the watchers were drunkenly grumbling over the fate that kept them out of the carousals and in the darkness. As the black and moving shadows reached them swiftly they soon were quiet and out of the darkness for evermore.

THE INTERRUPTED MARRIAGE

And the deer-eyed woman—a wife, yet still a maiden—was she happy? Oh, who knows! It may be that her eyes were not pain shadowed; that it was but the dim light of the wild wax tapers in the narrow vaulted chamber, and it may be that which glistened on her drooping lashes was but the flashing of stray light beams from between the entrance curtains. Who knows?

Merry were the wedding guests and well drunken most of them. More than merry was the bridegroom, who drank the deepest of them all. His brain was sodden, his limbs rebellious, but his tongue, though thick and clumsy, still responded to his call.

Sodden brain and clumsy tongue worked together as he mumbled loudly:

"As for the Lord of Chichen Itza—poor lean dog—let him take his pleasure howling at the moon tonight! Before I seek my wife's caresses in her many-curtained chamber, I must hear a lively song. Ehen! Holcanes! Tupiles! lift your voices and rattle out the battle song."

Drunkenly mumbling, stupidly fumbling, he rolled on his side and fell asleep.

At the holcanes' call the tupiles started the great war song of the Mayas—"Conex, Conex Paleche" ("Come on, come on, ye warriors").

The voices that commenced it were well known, though drunken and quavering; the voices that joined in it and ended it were strong, full, and shrilly menacing. Abruptly the drunken voices ceased and some ended with a groan.

The deer-eyed woman, alone in her curtained chamber, heard the voices and the singing, and then the strangeness of the tumult drove her to the carved stone entrance. Before she reached it the shells were rattled and the curtains parted swiftly. "Star of the night! Star of my life!" said Canek.

"My Lord Canek," said the maiden,

with startled eyes, but star lit.

Dead men, live men, and the live men dead in drunken stupor, what could the few with senses unbenumbed do against

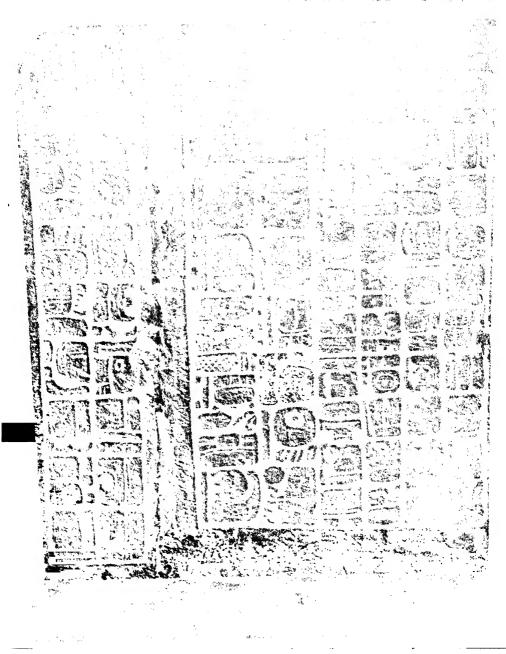


Photo by Edward H. Thompson

A PAGE OF STONE THAT NO MAN MAY YET READ

"How old is this great city of stone-built temples and myriad carvings? For years we have sought among its fallen columns and toppled walls for that which would tell us clearly of its age. To a certain extent the search has not been in vain. We have found a tablet of stone covered with hieroglyphs, and among them are signs that fix a date, an epoch. Keen minds and trained are now at work on the tablet, and the time may not be far distant when we shall know whether it be 2,000 years old or less, as some students claim, or over 11,500 years, as claimed by Le Plongeon" (see text, page 601).

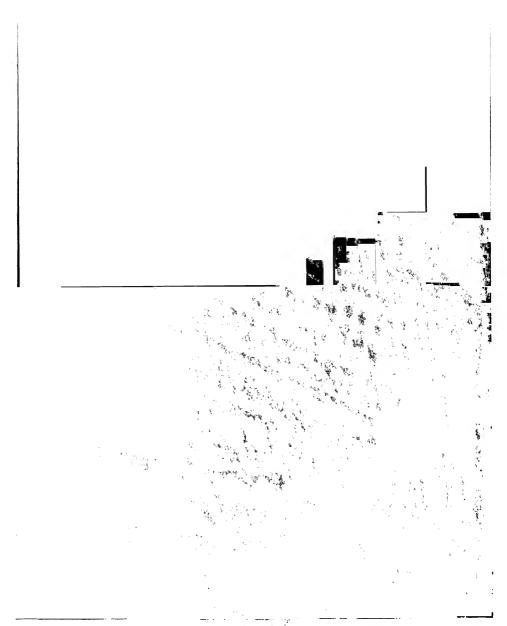


Photo by Edward H. Thompson

PHOTOGRAPH OF A HUMAN HEAD CARVED IN STONE: PORTION OF A RICHLY CARVED WALL SURFACE RECENTLY DISCOVERED AT CHICHEN ITZA

All the rolls of parchment and books on deerskin and agave paper, all the plans and records and the written lore of the mysterious city, Chichen Itza, were burned by the Spanish zealot, Bishop de Landa. When he saw the Maya symbols that he could not understand, he concluded that they were signs of a diabolical nature and caused them, together with many other objects containing Maya records, to be destroyed by fire on the public square of the city (see page 599).

the silent fury of Canek and his fighting men?

Never again did Chichen Itza know its Lord Canek, nor any of his band of fighting men. In the passing of a night they vanished, the Lord Canek and the soft-eyed maiden, the stolen bride of the drunken one.

Time passed. The lord who won a bride, but did not learn to keep her, lived his life, died, and was forgotten.

The memory of Lord Canek lived or in song and story and became a part of the legends of Chichen Itza.

THE LOST IS FOUND

One day, long after, a hunting band from Chichen Itza went toward the south—some days' journey. Young men they were and full of rashness, so they kept on the chase until the lane grew hilly and higher, and at last rose into the very clouds. Wonderingly, they turned homeward, journeying over a strange country, until they reached a lake of shining water, and in the lake an island city, with houses and temples and the carved fronts of many buildings like their own Chichen Itza.

From this island city warriors came and met them and led them to the waiting ruler and his aged wise men.

"Who are you, presumptuous ones, that you dare to come unbidden on our land and unwanted to our city?" asked the Batab in stern menace.

The young man spoke bravely, coolly: "We came from our home, Chichen Itza, and have wandered here unbidden because in the chasing of the deer we went farther than we knew; and, finding pathways right before us, we kept on, thinking to find old friends or make new ones."

The ruler turned and took counsel with his wise men, then said to the waiting hunters: "If your tale be true, that you are of Chichen Itza and not of another province, you will indeed find here old friends new made—old friends and new as well.

"This is the city of Tayasal, whose lord is Canek, who once was lord of your own Chichen Itza, the City of the Sacred Well."

This is the legend. The substance is

as told by the good old, but very dry, chronicler, Padre Cogolucco. I confess to have taken this skeleton and put a little flesh on here and there, just to round out the form—a little brown and red, just to give a local coloring, and so produce the true general effect; that is all. But perhaps I had better have left it as the ancient priestly scribe tells it; "quien sabe"—who knows?

Not all of the tales of Chichen Itza are

prehistoric or legendary.

Far later, chronologically, than the legend of Canek, a proven fact, with only a small portion of "information" embedded in it, is furnished us, and brings us down to the historic times of the early Spanish conquerors, when they were in deadly struggle with the fearless Mayas.

MONTEJO WELCOMED

In 1525-1526 Montejo was weary with his long and seemingly fruitless struggles against the native Mayas. Constantly buffeted by his countless enemies and having no place of refuge, he found himself in imminent danger.

The overlords of the provinces near the coast, known by the name of *Cheles* (bluebirds), were in a way friendly to the Spaniards, and Montejo found his way toward them. The other Indians, seeing that the Spaniards were headed coastward and thinking that they were sceking to return from whence they came, did not seek to fight or in any way annoy them; thus the Spaniards arrived safely at the home of the *Batabs Cheles*.

These received them hospitably and, in response to the petition of Montejo, allowed them to find a safe asylum at Chichen Itza, then governed by a vassal chief, Cupul.

Upon their arrival, Cupul, according to a native document, "The Narrative of Nahum Peck," said to them:

"Stranger lords, take your rest in these halls," and they did; they made themselves very much at home, after the manner of the Spanish conquerors of those days, even before they had fairly earned the proud title.

For a time the Indians bore the burdens that their guests put upon them with meekness, but at last they rebelled at

having to be the providers and burdenbearers for such lusty feeders and poor paymasters, and then their actions soon put the Spaniards in a serious plight.

Finally, besieged and almost without provisions, they took advantage of a stormy night after a brave sortie to deceive the Indians. One by one they deserted the edifice used as their garrison and stole away in the darkness, to unite and make for a more friendly haven.

DOG, ROPE, AND BELL

It is said that to deceive the Mayas into thinking that they were there they tied a dog to the rope of a bell and placed food in front, just beyond his reach. His frantic efforts to get at the food rang the bell at frequent intervals, while the constant bark aided the supposed deception of the Mayas, and when at last the ruse was discovered the little band of Spanish soldiery was nearly out of the enemy's reach.

Thus runs the chronicle, and the story may be true; but, knowing, as the writer does, the character and customs of the direct descendants of these same old Maya warriors, he does not believe it. It is far more probable that these Mayas, desiring to be quickly and peacefully rid of their burdensome guests, shut their eyes to the going of the Spaniards and would have been the more obliged to them if they had taken the bell and the dog along with them as well, and so left the besiegers to enjoy their early slumbers undisturbed. The discreetly dropped eyelid, that is almost a wink, and quickly changes into a blindness, is an artful act as ancient as the human race. In many respects the logic of the native Maya is peculiarly his own, but in many other ways his acts and artifices are as old as man himself.

ELOQUENT SILENCE

The writer has often been asked, "After one has visited the ruins of the Old World, is it worth while to visit those of the New World?"

He has had as visiting guests scientists of other lands, men with the wonders of Italy, of Egypt, and India fresh in their memory, inquisitive, incredulous, but desiring to see what there was to see.

As these great, lonely monuments loomed up before their vision, he has noted the quick, surprised intake of the breath, 'the change of color even, and then—a speaking silence far more eloquent than any words could be.

The American people should awaken to the fact that they have right at home, at their very doors, architecture essentially American, as it were, ruined structures every whit as interesting, as massive, and possibly as old as those of other lands, whose boast it is that the Americans must come to them, for "America has no ruins."

Within these mysterious ruins—American ruins—are great books, with pages of stone, writ in characters that no man may yet read. Are the mysteries they hold, the wonderful facts, that certainly lie sealed and mute within them, hidden from us, less interesting to Americans than are the tales of Egyptian dynasties, the rites of Druids, Roman campings, or Saxon raidings? I think not.



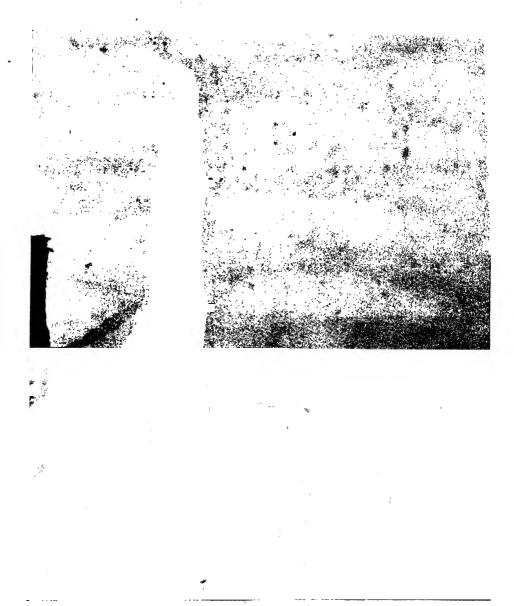


Photo by B. F. Langland

STONE SAILS AT GUADALUPE, MEXICO

Tradition has it that certain sailors who thought themselves lost in a storm vowed to the Virgin that if she would deliver them they would drag their mast to the top of the hill at Guadalupe and set it up as a memorial to her protecting power. They were delivered and fulfilled their vow, building sails of stone around the mast to protect it.

Photo by B F Langland

A MINICAN BEGGAR

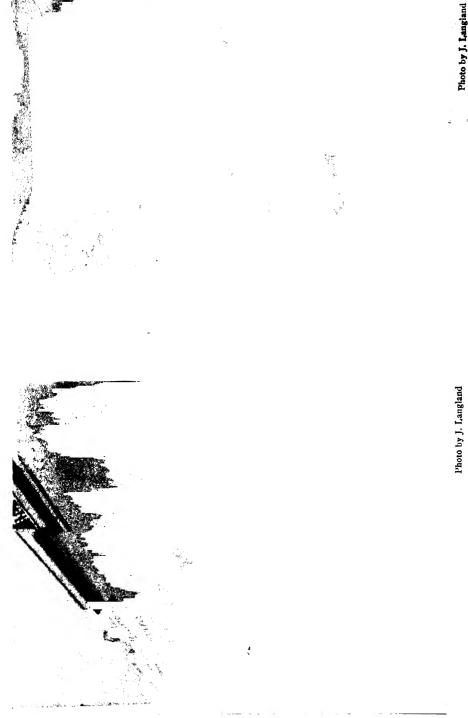
The beggar population of Mexico has always been a numerous one, in spite of rather sternly enforced laws against begging

spring burst forth beneath her feet. This chapel is over that well. It was built by the devout people, the women of the best families serving alongside the peons in the construction work. It is said that whoever drinks from this well must perforce return to Mexico. Juan Diego, and ordered him to gather flowers on the desert Tepeyac Hill to carry to the Archbishop as evidence of the apparition, a bubbling

When, according to tradition, the Virgin appeared before the Indian,

THE CHAPEL OF THE WELL AT GUADALUPE

Photo by B F Langland

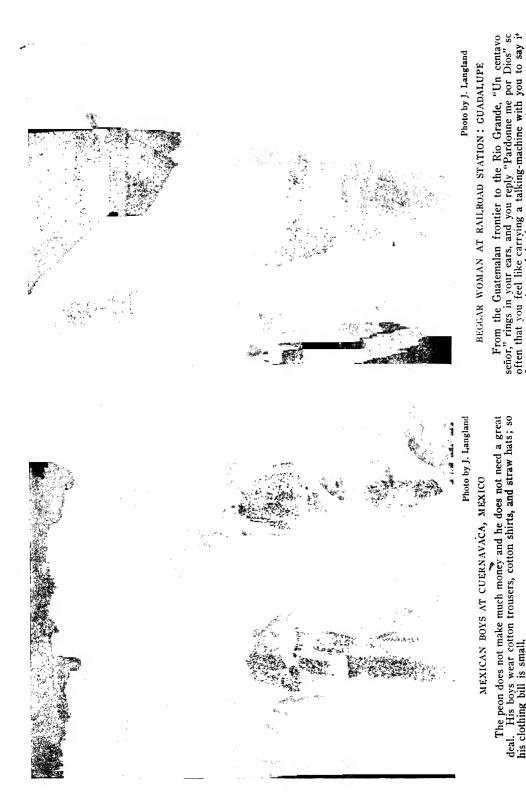


SELLING FOOD TO PASSENGERS ON A RAILROAD TRAIN: MEXICC NO traveler ever needed to go hungry in Mexico, provided he had a few centavos and an ability to forget the maxim of his childhood that "cleanliness is next to godliness."

Wherever you go you meet the Indian man wearing his sarape and the Indian woman her black shawl. These serve as clothing by day and as bedding by night.

THE SARAPE AND THE BLACK SHAWL

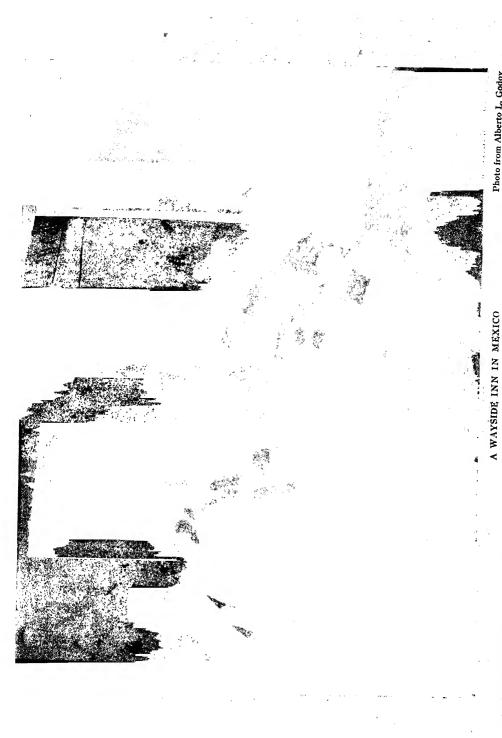
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for you every minute of the day.

deal. His boys wear cotton trousers, cotton shirts, and straw hats; so his clothing bill is small,

612



such places they know about as much about the germ theory of disease as a new-born babe knows about the fourth dimension, and they care Photo from Alberto L. Godoy

Photo by Charles Jenkinson The city of Guaymas is one of the principal seaports of the Gulf of California. Several railroads find their outlet here THE TOWN AND HARBOR OF GUAYMAS, MEXICO

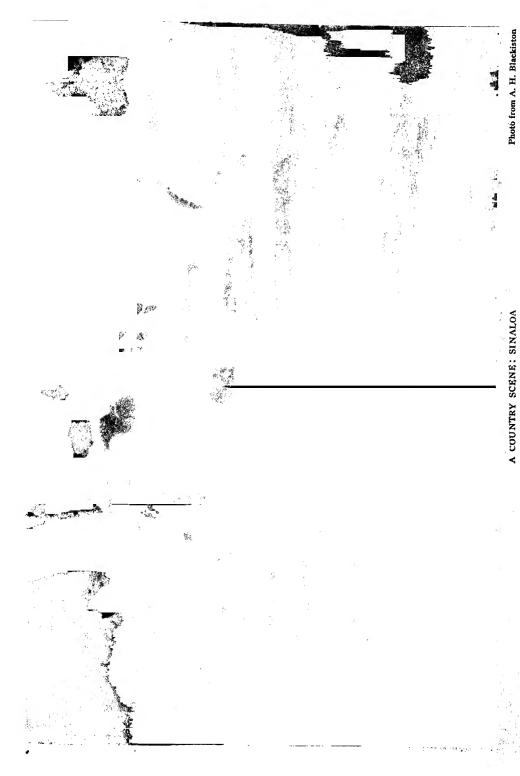
The outlying waters of Guaymas Bay are to the people of Mexico what the neighborhood of Catalina Island is to those of the United States. In years gone by fishermen from all points of the compass visited the fishing grounds of Guaymas. The Colorado River salmon, the jewfish, the Spanish mackerel, and the boca dute are there in abundance.

GUAYMAS, SONORA: MEXICO

Photo from Charles F. Holder



Nearly everybody who uses milk in Mexico boils it; and when one sees the conditions under which it is produced and marketed, he is a convert to pasteurization



The solid-wheeled ox-cart, the razor-backed hog, and the indifferent donkey are as much a part of the rural scene in Mexico as the self-binder, the herd of fat cattle, and the team of fine horses are in the United States



The Indian women come from far and near to the market day. It is no unusual sight to see one of them with a baby tied to her breast with a shawl, a load of wood in each hand, and a basketful of produce on her head



THE PYRAMID OF THE SUN: SAN JUAN TEOTIHUACAN

On this pyramid the Chinese Minister to Mexico, in 1911, found an inscription which is common on the burial places of China. Skirting the west base is the Path of the Dead, flanking either side of which are tumuli, which, when opened, were found to contain wrought stone sarcophagi, inclosing human bones, obsidian knives, and terra-cotta heads, the latter supposed to be the effigies of buried priests and kings (see also page 636)



Photo from Alberto L. Godo"

ON THE ROAD TO PACHUCA, DECORATED HERE AND THERE WITH RUINS OF EARLY SPANISH TIMES

The Conquistadores were great builders, and in addition to the fortresses in and around Pachuca, one finds here the ruins of one of the three most celebrated aqueducts in Mexico, built by the Franciscan Friar Francisco Tembleque.



AN OLD MEXICAN HIGHWAY

Photo by Alberto L. Godoy

The highways of Mexico wind in and out of mountain passes as they cross from one valley to another, and strings of burros and files of Indians going to market or returning are a familiar sight. Pachuca may be seen in the distance.

Photo by D. Basil W. Alexander A FOREST OF CACTI IN THE UPPER END OF SAN VICENTE CAÑON IN LOWER CALIFORNIA, MEXICO

Millions of acres of the highland region of Mexico are too arid for other vegetation than the cacti and the sage-brush. The above scene characteristic of the panorama that unfolds itself before the car window for hundreds of miles in the mainland highlands, as well as characteric of the northern part of the Lower California Peninsula.

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Photo by D. Basil W. Alexander

ANOTHER VIEW OF THE CACTI IN SAN VICENTE CAÑON, LOWER CALIFORNIA, MEXICO, SHOWING THEIR IMMENSE SIZE

Mexico has a majority of the more than 500 species of cacti, ranging from the candelabra, with its great branches, which give it its name, and the organ, with its fluted pipes and thorns with saw-tooth edges, to the creeping kinds that scarcely rise above the ground.



Photo by A. W. Cutler

A Tehuana Indian beggar at Tehuantepec, Mexico. Her hat consists of half a cocoanut cleaned out and polished. A whole cocoanut can be purchased for something less than a penny.

A QUEER HEAD-DRESS

Photo by A. W. Cutler THE WATER-CARRIER One of the many methods of carrying water adopted by the Tehuana Indians of Tehuantepec, Mexico

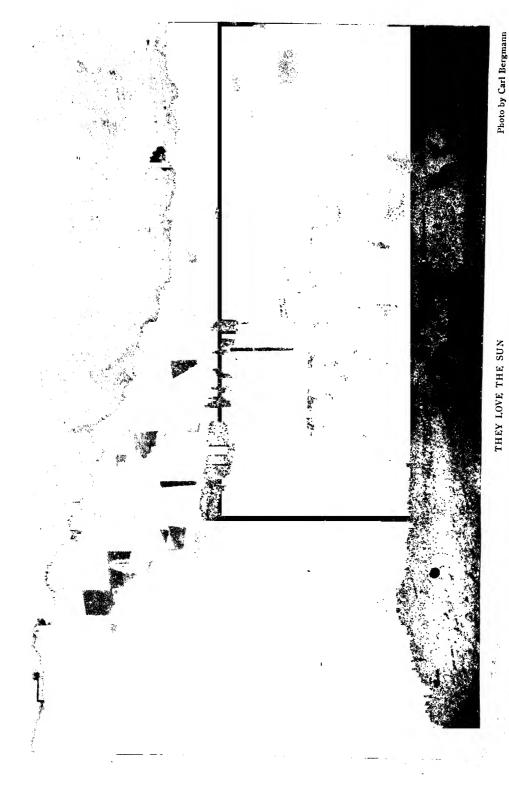


IN THE SAN PABLO REGION, MEXICO

The small farmer of the semi-arid regions of Mexico has a rather disheartening fight for existence. His crops are limited in range, being mainly corn and beans, and they are usually short, affording him and his family only the barest necessities of life. Note the fences of cactus Photo from Alberto L. Godoy



Highland Mexico abounds in aqueducts which carry water long distances. Some of them have watch-towers, where sentries are stationed to protect them



In the highland cities of Mexico the poor congregate in the small plazas and contentedly sun themselves, getting the chill of the cold and coverless nights out of their bodies. The quick-lunch counter is always there to cater to their wants, even though they have very little money to



Photo by C. M. Tozze

LACANDONE WOMAN SPINNING THE NATIVE COTTON pindle rests in a gourd and the mass of crude cotton rests on shoulder: Yucatan

A MAYA WOMAN GRINDING CORN WITH A STONE METATE. She is the descendant of a proud race that is said to have been the only one of the Western World that made any progress toward

Photo by C. M. Tozzer

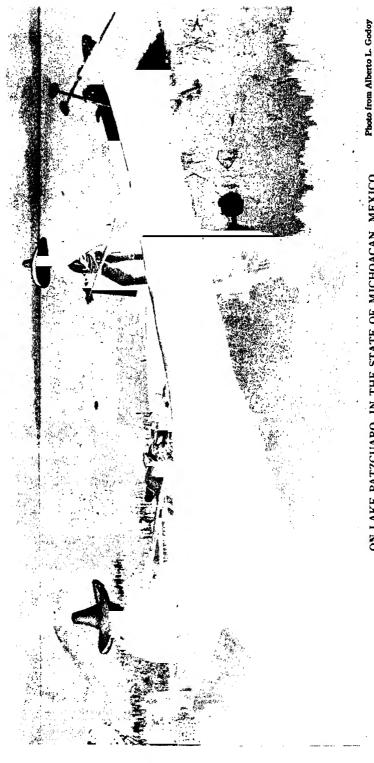
a phonetic system of writing. They were conquered by the Spanish in the great battle of Merida, in 1540, and every possible remnant of their civilization put to the torch (see page 606).



MEXICAN CHARRO AND HIS HAT

Photo from H. Ravell

What leather breeches and "chaps" with their elaborate fringes mean to the American cowboy of the old school, the big sombrero means to the "man on horseback" in Mexico. His hat may cost half as much as his horse, and his sarape may match the rainbow for colors. When the elder Diaz attired his "rurales" in such a uniform there was always a waiting list.



ON LAKE PATZCUARO, IN THE STATE OF MICHOACAN, MEXICO

With its surface a mile and a quarter above the sea, and with a circumference of thirty miles, Lake Patzcuaro is one of the most beautiful inland lakes in the world. It abounds in water fowl, and many fishing and hunting expeditions are made to it by the Tarascan Indians, q



A RURAL KITCHEN IN MEXICO

Photo from A. H. Blackiston

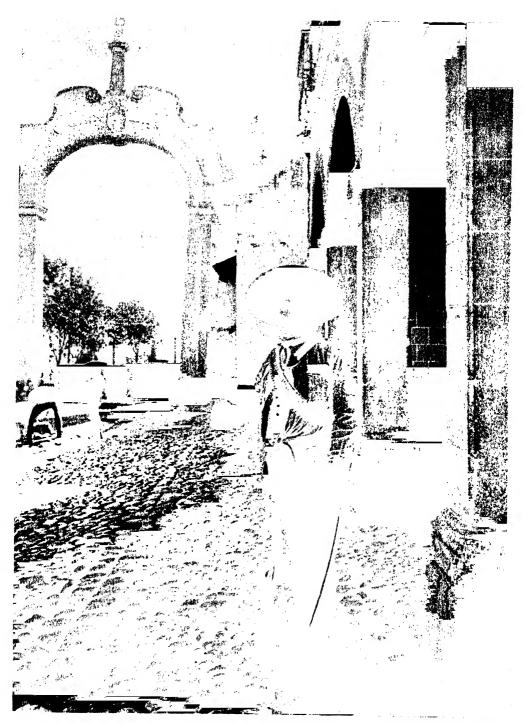
The kitchens of rural Mexico may not measure up to the standard of those of the rural American housewife but the Mexican would not trade his hot tamales, chili concarne, frijoles, and tortillas for the best chicken, ham, asparagus on toast and light rolls that the American housewife can prepare.



THE PYRAMID OF THE SUN

Photo from Alberto L. Godoy

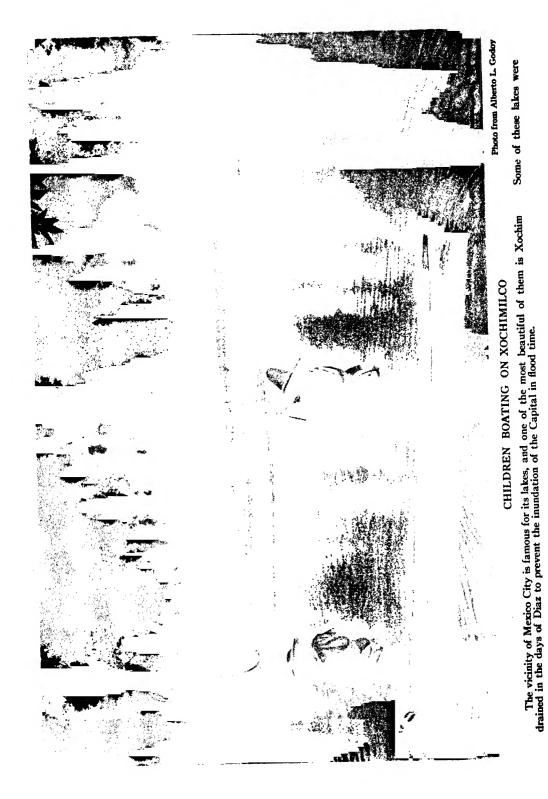
What Cheops is to Egypt, such is the Pyramid of the Sun to Mexico. Its base is about as large as that of Cheops, and it is 216 feet high. All we know of its origin is that it was built before the Toltecs occupied the Valley of Mexico. According to tradition, a splendid temple once crowned its summit, and contained a great monument to the sun made from a single block of porphyry. Excavations have revealed galleries and vaults like those of Cheops, and Senor Garcias Cubas, the eminent archeologist, says that a gallery in the companion pyramid, that of the moon, coincides exactly with the magnetic meridian.



A RURAL GUARD ON DUTY

Photo from Alberto L. Godoy

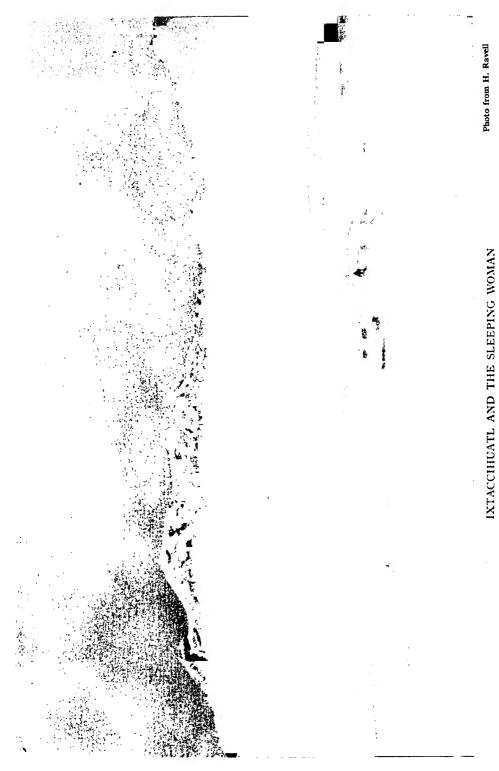
When Porfirio Diaz came into power the country was infested with robbers from the mountains to the sea. He selected the best and made a rural guard out of them. They justified his hopes, and after a while it became as safe to travel in Mexico as it is to travel in the United States. The prolonged civil strife has sadly thinned their ranks, however.





THE HAPPY MEXICAN INDIAN

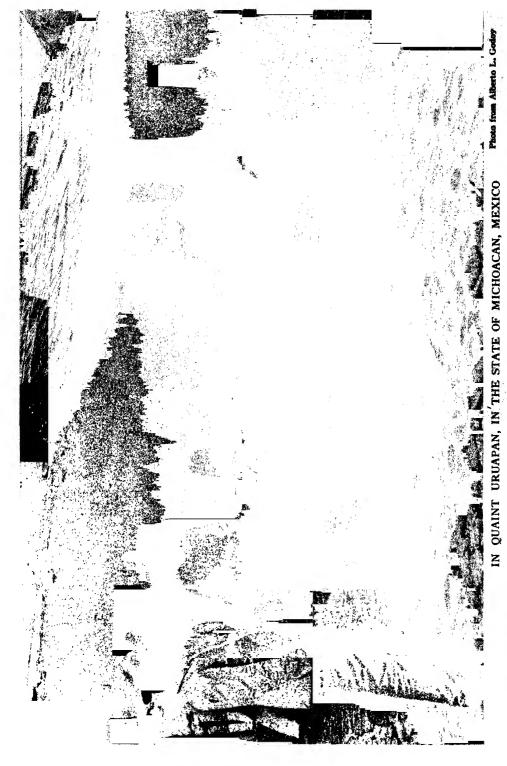
Left to himself and not forced to comply with the trammelling conditions of civilization, the Mexican Indian worries neither about the past, the present or the future. He finds that "sufficient unto the day is the evil thereof," and so he cats when he can, drinks when he pleases, and is merry when it suits him to be.



The "man on the mountain" in the Catskills is matched by "the sleeping woman on the volcano" in Mexico. As seen from Tlalpa n the hair of the sleeping woman seems to be streaming down the one end of the mountain.



The two majestic volcances, Popocatepetl and Ixtaccihuatl, with their caps of perpetual snow, stir the heart of him who beholds them. From the summit of Ixta, 16,200 feet above the sea, one sees Popo, Orizaba, Xiantecal and Matlacueyall litting their lofty cones above the summit of Ixta, 16,200 feet above the sea, one sees Popo, Orizaba, Xiantecal and Matlacueyall litting their lofty cones above the ribuds. Across the saddle between Popo and Ixta Cortez built the military road that led him to the capital of Montezuma.



Where once the Indians of Uruapan fashioned the famous Uruapan lacquer ware, today the people are engaged in growing silkworms. Many of the sunny patios of the small houses are brilliant with the scarlet blossoms of the shepherd's flower. The Spaniards call the



THE WATER CARRIER

Photo by John H. Hall

In every part of Mexico the water carrier flourishes. He gets the water from some spring or clear stream, and the people seem never to inquire about the presence of colon bacilli and only a few of them ever boil the water, which helps to account in a measure for the high death rate in Mexico.



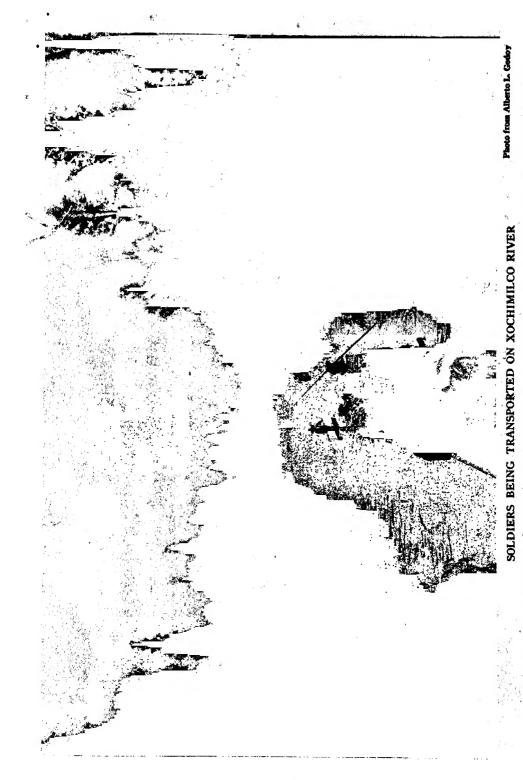


A MEXICAN HAT STORE

The lower class Mexican is fastidious about only one thing in the world—his hat. And the Mexican hat store carries a line that gives him plenty of room to exercise his fancy and to deplete his already slim pocketbook.



The people of Mexico do not go to any great trouble in building their country roads, and when they sence them they simply put cacti sprouts into the ground, and the sence grows.



The Mexican peon fights because he has to, but with all that, given good generalship and enough to eat, he makes a good soldier. "Volunteers" are usually brought to camp tied with ropes or handcuffed.



THE SPAN OF AN AQUEDUCT

Photo from Alberto L. Godoy

Most of the great mining centres of Mexico are located in the highlands where rain seldom falls and where the water supply must be brought for dozens of miles from the mountains.

DISCOVERY AND INVENTION

By Alexander Graham Bell

AM going to begin tonight by asking you a rather startling question: Did you ever put your head under water and chuck two stones together to see what the sound is like? If you have never done that, try it, and you'll get a new sensation. I did it once, and it sounded at if a man were hammering for all he was worth at my very ear

I then took two tiny little pebbles and tapped them together, quite lightly under water, and it sounded like a man knocking at the door. It was rather startling to hear such a loud noise from such a

slight cause.

Of course, the question at once arose in the mind: How far off could we hear the sound? So I sent a boy a hundred feet up the beach with a couple of stones, directing him to strike them together under water. I then submerged my head, and I could hear the sound about as read-

ilv as before.

Well, I determined to test the maximum possible distance, and sent the boy across the bay in a boat to the other side, to a point at least a nille away from the place where I stood, and I followed him with field glasses to see that he carried out my instructions. I saw him land on the other side, take off his coat, roll uphis sleeves, and go down to a little plank wharf on the shore rising only a few inches out of water. He lay down upon the wharf, face downward, and put his hands into the water, and I then knew he was making signals with these stones.

Now, the question was: Could I hear him? Quietly and gently I went into the water at my side of the bay, submerged my head, and listened for all I was worth. Well, you know, the signals came perfectly clear and distinct, through more than a mile of water, to my ear. It was one of the most astonishing revelations of what could be done with water.

You know if you look away in the distance at a man firing a gun you can see the flash, and after a time you get the

report; the sound takes time to travel through the air. It goes about 1,100 feet per second; but in the water it goes five times as fast as that—over 5,000 feet per second. Water is a much better conductor of sound than air.

DO FISH SIGNAL TO ONE ANOTHER BY SOUNDS?

Reflecting upon these various experiments, the thought occurred: If two little stones tapped together can be heard under water, why, every tiny lobster that snaps his claws must make an audible click. I wonder if there are creatures in the water that signal to one another by sound.

Well, I had occasion to try it once. Bathing in the Grand River in Ontario a great many years ago, I put my head very gently under water and listened, and, sure enough, "tick, tick," came a sound like a grasshopper's chirrup, and a little while after that a chirrup on the other side. There were creatures under the water that were calling to one another.

I don't know whether all fish make sounds or not, but there are some fish that certainly do. The drumfish on our coast drums away in the water so loudly that you can hear him while you are walking

on the shore.

It is also a significant fact that all fish have ears. Why should they have ears if there is nothing for them to hear?

Of this we may be certain—that there is a whole world of sound beneath the waves waiting to be explored, perhaps by

some of you.

I have wanted you to see how one observation leads to another. Starting with a very small thing—the chucking together of two pebbles under water, and following this up by other observations—we broaden our field of knowledge and reach generalizations of considerable magnitude as the resultant of numerous small thoughts brought together in the mind and carefully considered.

*An address to the graduating class of the Friends' School, Washington, D. C., delivered May 22, 1914.

THE NATIONAL GEOGRAPHIC MAGAZINE

OUT OF THE BEATEN TRACK

I was walking along the road one day in my country place in Nova Scotia, when the idea occurred to leave the beaten track and dive into the woods. Well, I had not gone 50 feet before I came upon a gully, and down at the bottom was a beautiful little stream. I never knew of it before.

Of course, I was not satisfied with the mere discovery, but went down into the gully and explored it right and left. I followed it up to its source. I followed it downward for half a mile, through a beautiful moss-grown valley, until at last the little streamlet discharged into a pond, and away in the distance I could see a sea beach with the open water beyond.

Now, just think of that! Here was a beautiful gorge, half a mile long, right on my own place, and coming at one point within 50 feet of a well-trodden road, and I never knew of its existence before. We are all too much inclined, I think, to walk through life with our eyes shut. There are things all round us and right at our very feet that we have never seen, because we have never really looked.

Don't keep forever on the public road, going only where others have gone and following one after the other like a flock of sheep. Leave the beaten track occasionally and dive into the woods. Every time you do so you will be certain to find something that you have never seen before. Of course it will be a little thing, but do not ignore it. Follow it up, explore all round it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought.

THE BEGINNINGS OF INVENTION

I dare say you have all heard of that celebrated painter who would never allow any one to mix his colors for him. He always insisted on doing that himself, and at last one of his students, whose curiosity had been aroused, said: "Professor, what do you mix your colors with?" "With brains, sir," said the professor. Now, that is what we have to do with our observations.

I think I left you with your head under water listening to the clicking of two stones. Now, let us see whether we cannot use our brains to get you out of so awkward a predicament. We will then have entered the realm of invention, as distinct from discovery.

Why should we not simply put the ear to the water instead of submerging the whole head?

Why should we not ring a bell under water instead of clicking stones together to make a noise. An ordinary dinner bell would do. Empty it of air and ring it under water, and the sound can be heard by a submerged ear at a great distance away.

It is a little awkward, however, to keep the ear continuously submerged on account of the movements of the surface water. Every now and then a little wave will slap you in the face, and you are apt to choke if you are caught unprepared.

Why would it not be better to transmit the sound vibrations from the water to the ear through some intervening mechanism, and thus obviate the necessity of submerging the ear at all?

I have tried submerged hearing tubes of various kinds and planks of wood partially submerged, with the ear applied to the part out of water.

If you put want ear to the bottom of a boat—inside, of course, not outside—you can hear a bell at a distance quite readily. It still is a little awkward, however, to get your ear against the planks of the boat; but brains will help you out. Just fix a telephone transmitter to the planks of the boat, and you can sit at ease with the telephone receiver at your ear.

You may even put the telephone transmitter overboard. It then becomes a submerged ear and will listen for you under water.

FISHING WITH TELEPHONES

I have often thought I should like to go on the banks of Newfoundland and fish with a telephone. If you were to send the transmitter down among the codfish with the bait, perhaps you would find something there to hear. I have never tried it. I will leave that to you.

We now have numbers of steamers.

upon the Atlantic fitted with telephone transmitters attached to the thin iron skin of the hull, away down in the hold, and the receiving telephone on the bridge.

On shore there are huge bells at lighthouse stations making fog-signals under water, and each steamer as it approaches the coast can pick up these submarine sounds at a distance of 10 miles.

Here is a completed invention which some patient observer has evolved from just such little beginnings as those I have the cribed

described.

I doubt whether you could hear a fogsignal through the air at any such distance as that. The air is at best but a poor conductor of sound, and many illusions of hearing are possible.

It is difficult in any case to tell the exact direction of a sound in a fog. It is possible, too, that you might have an echo from the sails of a vessel, and you would then be entirely misled as to the direction of the signal station.

Then, again, an island anywhere near casts a sound-shadow upon the water. The sound-wave striking the island is deflected up into the sky, and you would have to go up in a balloon to hear it, and it may not come down again to the surface for a mile or two beyond the island. A ship quite close to the island might not hear the sound. The captain, knowing that the fog-horn should be heard at least a mile or two away, imagines himself to be much farther off than he really is, and in the midst of the fog he may become conscious of the presence of the land only by actual contact with it.

Then the transmitting qualities of the air are subject to variations on account of unusual atmospheric conditions. You may be quite near a fog-signal station and yet hear the sound so faintly that you imagine it to be far away. You may even get an echo from the clouds; but then you know you are subject to an illusion, for the sound seems to come from the sky.

Now, sounds can be transmitted through the water to far greater distances than through the air, and atmospheric conditions have no effect.

I don't want to confine your attention to inventions that already have been made. I want to show you also that there is room for something new. We don't know everything yet and the list of possible inventions is not yet closed. Take, for example, the case we have been talking about, the transmission of sound through water.

EXPLORING UNDER THE SEA

Three-quarters of the earth's surface is under water and has not yet been explored, at least to any great degree. The only way we have of reaching the mountains and valleys at the bottom of the sea is by sending down a sounding line and bringing up a specimen of the bottom attached to the sinker. It is no joke, however, to reach the bottom of the deep, blue sea through one mile or even two miles of water, and it takes several hours to make a single sounding. Just think of all the time and labor involved in merely ascertaining the depth.

Why should we not send down a sound instead and listen for an echo from the bottom. Knowing the velocity of sound in water and the time taken for the echo to reach the ear, we should be able to ascertain the depth of the deepest part of the ocean in less than four seconds instead of more than four hours. Here is something worth doing. It has never been tried. I have suggested it a number of times, and I will now pass on the thought to you in the hope that some of you may care to take it up.

Suppose you are on one of those steamers provided with transmitter hulls and telephone ear-pieces, and you send down a little piece of gun-cotton or other explosive material to a safe distance below your ship and then explode it by an electrical contact. The sound-wave from the explosion will, of course, go down to the bottom and then be reflected up again, so that after a certain length of time you should get an echo from the bottom.

Not only should you be able to tell the depth of the ocean by an echo from the bottom, but you might perhaps learn something of the nature of the bottom itself. A flat bottom should yield a single sharp return, whereas an undulating bottom should yield a multiple echo, like that heard when you fire a pistol among hills.

Then, as you approach the shore you should get resonance effects, like those perceived when you shout out loudly in

an empty cave.

However, I must not take up your time in speaking upon only one subject. What I want to direct your attention to is that both discovery and invention are not things that come all at once. They arise from very simple beginnings. A small observation, patiently followed up by other observations equally small, leads gradually to a big conclusion. Do not ignore little things; life itself is made up of them, and there is a good old Scotch saying that bears upon the point:

"Mony a mickle maks a muckle."

A great many small things make a big one. Any one, if he will only observe, can find some little thing he does not understand as a starter for an investigation.

AN EXPERIMENT AT HOME

I had rather a curious illustration of this the other day in my own house. I told a lad who was waiting upon me that I wanted to make some experiments with a bottle of water, and told him to bring a bottle of very hot water from the kitchen, and be sure that it was quite full. He soon returned with a big-bodied bottle provided with a long and narrow neck, filled to the brim, and put it on the mantelpiece and went downstairs. After the water had cooled, I rang the bell for John.

"John," I said, "I thought I told you to fill that bottle quite full."

"So I did, sir," he replied.

"Well, look at it now; it's not nearly

full; the neck is quite empty."

John assured me that he had not touched the bottle since he first put it up, and I assured him that I had not poured any of the water out.

"Well," I said, "what has become of

the water?"

He was quite nonplussed at first, and then he began to—to—ratiocinate, and said: "The water was quite hot when I put it in; there was steam coming from it. The water must have evaporated."

I made no comment, but looked at him and said: "Let's try it again. You fill that bottle chock full of hot water this time, and then cork it so that no steam can escape."

He did so; and by and by I rang the

bell again, and up came John.
"John," I said, "I thought you filled that bottle quite full."

"So I did, sir," he replied.

"Well, look at it now; it's not nearly John assured me that he had not touched the cork, and I replied: "Well, what has become of the water?" John said he didn't know. He admitted tha some of it had evidently gone, but where it had gone he couldn't for the life of him conceive, and he hasn't found out yet.

I am sorry now I didn't think of telling John to weigh the bottle when he first brought it up, for by weighing it again he could have found out exactly how

much had disappeared.

If John hadn't given up he might have arrived by degrees at a realization of the principle upon which a thermometer works.

A thermometer is an instrument for measuring heat, and whenever you can measure a phenomenon you have a basis upon which may be built a science; in fact, all science is dependent upon measurement.

When you measure heat you get the science of thermo-dynamics, and thermothis and thermo-that. When you measure the pressure of the atmosphere by a barometer you lay the basis for the science of meteorology and a whole lot of sciences dependent upon atmospheric measurements. So you have sciences based upon the measurement of sound and light; but you have no science of odor.

MEASURING AN ODOR

Did you ever try to measure a smell? Can you tell whether one smell is just twice as strong as another. Can you measure the difference between one kind of smell and another. It is very obvious that we have very many different kinds of smells, all the way from the odor of violets and roses up to asafetida. until you can measure their likenesses and differences you can have no science of odor. If you are ambitious to found a new science, measure a smell.

What is an odor? Is it an emanation of material particles into the air, or is it a form of vibration like sound? If you can decide that, it might be the starting point for a new investigation. If it is an emanation, you might be able to weigh it; and if it is a vibration, you should be able to reflect it from a mirror. You can reflect sound and light and heat, and I have even warmed my hands at the reflection of a fire in a mirror. Not a glass mirror, for glass is opaque to radiant heat. sheet of transparent glass makes a fine fire-screen. You can see the fire through it, but it cuts off the heat. When you try to reflect it from an ordinary lookingglass, the heat has to go through the glass in order to reach the reflecting surface behind and then pass through the glass a second time in order to get out. Take a sheet of polished metal—tin-foil will do—or any metal with a bright and shiny surface and you can reflect heat from it with ease.

Can you reflect a smell or measure its velocity of transmission? If you can do those things you will be well advanced on the road to the discovery of a new science.

THE SMELL OF TELLURIUM

Well, that reminds me of a discovery that started with a smell. We have a very rare elementary substance known as tellurium, and when you melt it with a blow-pipe it gives off a smell. We can't measure it, nor even describe it; but if you have ever smelled it you will know it ever after. There is nothing in heaven or on earth that smells like that.

Now, you know it is the object of many chemists and scientific men to turn their discoveries to some practical use. They try, through chemical and other means, to convert waste products, for example, into useful things. Indeed, the utilization of waste products is a characteristic of the age in which we live.

Just think what they have done. Here is a gas manufactory consuming coal. After the gas has been produced we have left upon our hands ashes and clinkers and a lot of evil-smelling tar. Well, the chemists go to work and out of that tar they make the most delightful perfumes

for scenting handkerchiefs, and nice sweet essences for flavoring puddings, and the most beautifully colored dyes, all made from coal-tar.

Now, there was a distinguished chemist who thought he saw a chance of making something valuable out of the waste products obtained in the manufacture of sulphuric acid. Some of the powder he obtained he heated with a blow-pipe, and at once perceived the characteristic smell of tellurium. Here, he thought, was a rare and valuable element contained in a common and cheap by-product and it might pay to extract it. He then applied various chemical tests, but could get no other indication of the presence of tellurium excepting the smell. All the reactions declared there was no tellurium there.

Ile did not stop with this observation, but followed it up and began reasoning about it. If, he thought, there is no tellurium here, there is certainly something that has a smell very like it, and I know of no other substance on earth that has a smell like that. Perhaps there may be a new substance here, not yet discovered, which resembles tellurium, at least in the smell.

He knew that he was working with a regular conglomerate or mixture of all sorts of materials, many of which he could identify. He then extracted from the mass all the materials he knew were there to see if there was anything left; and, sure enough, a residue appeared which turned out to be, as he had suspected, a new elementary substance not heretofore known to man.

SELENIUM FOUND

He termed this substance selenium because it resembled tellurium. The word selenium, you know, is derived from a Greek word meaning the moon, and tellurium comes from the Latin—tellus, the earth. The two substances were not identical, but were related to one another as the moon is to the earth.

Selenium was found to resemble black sealing-wax in appearance. It had a beautiful, black, glossy surface, and in thin films was transparent, showing ruby red by transmitted light. In this, its vitreous form, it was a non-conductor of electricity, thus differing in a remarkable degree from tellurium, which was a good conductor.

When, however, selenium was heated almost to the fusing point and then allowed to cool very slowly, it completely changed its appearance. It acquired a dull metallic look, like lead; and in this, its crystalline condition, was also found to be a conductor of electricity, but of extremely high resistance. A little pencil of crystalline selenium not much more than an inch in length offered as much resistance to the passage of an electrical current as 96 millions of miles of wire, enough to reach from here to the sun, and yet it was a conductor. That was a discovery. Now comes an invention.

Willoughby Smith, in laying the Atlantic cable, found it advisable to balance the electrical resistance of the cable during the process of submersion by tremendous coils of well-insulated wire. Why, thought he, should not a little bit of selenium balance the whole cable and enable us to get rid of all this complication of wire.

He succeeded in doing this, but found the electrical resistance very variable. At times the selenium would balance the whole cable and at other times not onehalf of it.

He did not stop with this observation, but sought the cause of the variation. He multiplied observations, and his assistant, Mr. May, soon discovered that the resistance of the selenium was greater at night than in the day.

This at once suggested to Willoughby Smith the thought that perhaps the electrical resistance of selenium was affected by light, and he proceeded to put his idea to the test of experiment. He shut up the selenium in a dark box near a bright light, and found that when the lid was open the resistance went down and when it was closed it rose again. Even a shadow falling upon the selenium affected its electrical resistance.

SPEECH FROM A SUNBEAM

Then other scientific men took the matter up. Professor Adams, of King's College, England, discovered that the resistance varied directly with the intensity of the light that fell upon the selenium. Then I came along with some speculations concerning the possibilities of telephoning without wires by varying the intensity of a beam of light by the action of the voice, and allowing the light to fall upon a piece of crystalline selenium. In this way I thought it would be possible to get speech from a sunbeam.

Well, I need not go into the details, but it was true. I produced the photophone, an instrument for talking along a beam of light instead of a telegraph wire. It is interesting to remember that all these things resulted from the observation of a smell.

When I was invited to talk to you tonight I had no idea of what to say. I thought of all the good maxims for your future conduct in life; but giving advice to young people is out of my line, and it seemed to be better to choose some subject with which I was a little familiar myself.

How discoveries and inventions arise from the observation of little things is surely a topic worthy of your consideration. I also thought it would be interesting for you to know how many apparently impossible results have been actually achieved by the patient multiplication of little observations.

It was only a short time ago that if you wished to express the idea that anything was utterly impossible you would say, "I could no more do that than I could fly." I don't think there is any one here who is too young to have heard that expression. It was the height of impossibility that we should fly, and here men are flying in the air today.

It is only a few years since the first man flew, and we are only at the beginning of aviation. What a delightful idea it is to go sailing through the air. The only trouble is that you must come down, and we have altogether too many fatalities connected with the work. Here, then, is a subject for you to explore: How to improve the safety of the flying machine. How to produce flying machines that any one can fly.

We know perfectly well that the time is coming, and is almost here, when it will be an every-day thing to go from place to place through the air. Perhaps some of you may find a field of occupation in bringing this about.

FLYING ACROSS THE ATLANTIC

Even today we have startling propositions to do things that are apparently impossible. A man proposes to try this summer to fly across the Atlantic Ocean in a heavier-than-air flying machine. The strange thing about the matter is that experts who have examined into the possibilities find that he really has a fighting chance.

You see the distance is less than 2,000 miles from Newfoundland to Ireland. This means that if you could go at 100 miles an hour you would cross the Atlantic in 20 hours—less than a day. Just think of that. Well, we have flying machines that go at a greater speed than that. We already have machines that could cross the ocean if their engines can keep going for 20 hours.

Of course, these are exceptional machines; but even the ordinary machines of today make 50 miles an hour with ease. Now, a flying machine flies faster as you go higher up, because the rarer air offers less resistance to the motion, while the propeller gives the same push with the same power, whatever the elevation. As you get into rarer air the propeller simply spins round faster.

A 50-mile-an-hour machine flying two miles high in the air—and we have machines that have gone twice as high as

that—will fly much faster than 50 miles an hour.

Then at an elevation of two miles high in the air there is a constant wind blowing in the general direction of Europe having a velocity anywhere from 25 to 50 miles an hour.

As the net result of all these things, there can be little doubt that any ordinary machine that is able to support itself in the air at an elevation of two miles high will attain a speed of at least 100 miles an hour in the direction of Europe, and that means going from America to Europe in a single day.

Calculation shows that, taking all these circumstances into consideration, our best machines should be able to cross the Atlantic in 13 hours. I hardly dare to say it aloud for publication. It is sufficiently startling to know that it is not only possible, but probable, that the passage may be made in a single day. But if, as I imagine, it can be done in 13 hours, you may take an early breakfast in Newfoundland and a late dinner in Ireland the same night.

Now, I will not take up any more of your time. My idea has been to point out to you how great discoveries and inventions have originated from very little things, and to impress upon your minds the importance of observing closely every little thing you come across and of reasoning upon it.

Indeed, as Smiles very happily puts it, "The close observation of little things is the secret of success in business, in art, in science, and in every pursuit in life."

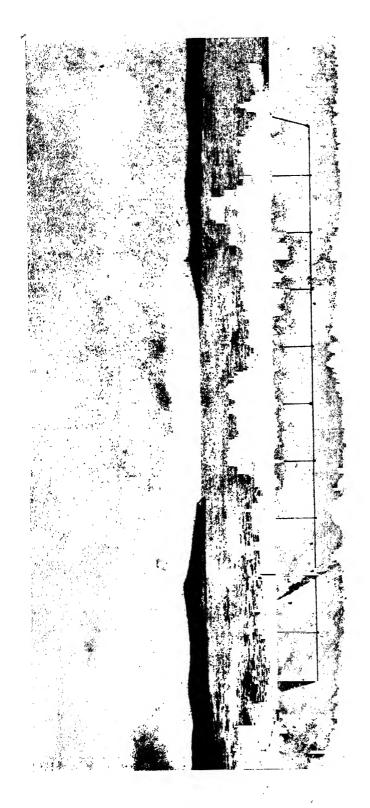
OUR GUARDIANS ON THE DEEP

By WILLIAM JOSEPH SHOWALTER

N A very general way the people of the United States know that there is a government bureau in Washington called "The United States Coast and Geodetic Survey." Yet little indeed do they appreciate its many activities—activities which touch them, even though they are unconscious of the contact, almost every hour of every day of their lives.

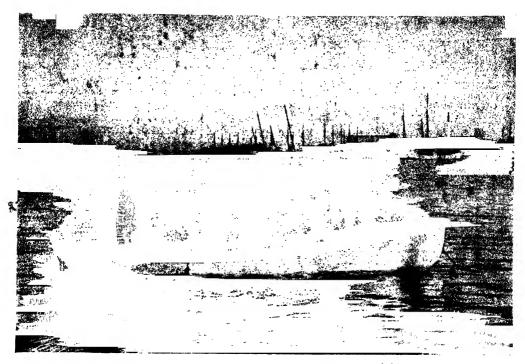
Do they or their friends go down to

the sea in ships, the Coast and Geodetic Survey stands between them and the perils of the deep, by furnishing the sailing directions that preserve those ships from harm. Do they live on lots that have been surveyed and on streets that have been laid out by a civil engineer, the Survey has contributed to the accuracy of the work. Do they drink water from city water mains, the fundamental



THE SWEEP WITH WHICH THE COAST SURVEY FINDS SUNKEN ROCKS

as the wire sweep, and consists of a wire of any desired length, supported at intervals by buoys so arranged that the wire can be lowered to any given depth. The sweep is then attached to two or three small power-boats, depending on its length, and is towed slowly along. The wire catches upon any obstacle that it encounters. This obstacle is then further investigated by means of lead soundings. These wire sweeps vary in This is the most reliable apparatus yet devised for discovering the dangers to navigation that lurk beneath the surface of the sea. It is knowr size from 100 feet to over a mile in length, and have been used to a depth of 45 feet (see page 660).



RUNNING A LINE OF SOUNDINGS (SEE PAGE 659)

This picture shows a sounding party in Baltimore harbor. The two observers are seen determining the position of the boat by sighting with their sextants upon beacons on the shore. In the bow the leadsman stands ready to cast the lead, while amidships is the recorder, all ready to note down the observations.

leveling work of the Survey enters into the consideration. In a hundred ways the work of the Coast and Geodetic Survey comes home to every one, and behind the curtain of its somewhat puzzling name it is engaging in a wide range of wonderfully interesting as well as useful activities.

WE HAVE 40,000 MILES OF SHORE-LINE TO BE CHARTED

In these days of great steamships and vast commerce it is necessary that minute information concerning our coastal waters be in the hands of navigators. A single sunken rock in the path of water traffic may send hundreds of souls to the bottom of the sea; a single point of shifting sands carried hither or thither by river or ocean current may ground a steamer; a single unplotted wreck on the bottom of a harbor may do millions of dollars' worth of damage.

For 96 years the work of charting our

coasts and making safe the water roads along our shores and within our harbors has been going on. Rather a long task it has been; but then we have rather a long coast-line to survey. According to trend, it is 16,000 miles long; but when it is measured so as to include the shore-line of all large islands, bays, sounds, and estuaries within tidal range, it becomes upward of 40,000 miles long.

Furthermore, that coast-line is never the same. Its main features may be as fixed as the eternal hills, but many of its smaller features are as unstable as the shifting sands of the desert; and these affect every ship that sails its waters. Between 1835 and 1908 Rockaway Beach, near New York, grew to the westward at the rate of nearly 8 inches a day. In 73 years Coney Island's western end has shoved itself farther westward about 1,000 feet. When Vancouver explored Columbia River he found a single straight channel there. By 1851 Sand Island had

appeared, creating a second channel. Since that time it has moved two miles in a northwesterly direction, and finally has closed up the northern channel.

OWING TO WINDS, TIDES, AND RIVERS, THE WORK IS NEVER COMPLETED

It is obvious therefore that the work of surveying our coast-line can never be finished, because the winds, the tides, and the rivers continually alter its minor details, thereby making new investigations necessary. These changes must be kept track of and charted and the mariners warned against them, else, confiding in the accuracy of the charts, they would literally be led into unsuspected traps. The location of all lighthouses, buoys, artificial and natural objects on the shore must be charted, and every other aid to navigation that will tell the skipper of any ship exactly "where he is at" and keep that information at hand all the time. Piers and deepened channels change the conformation of a harbor, and sand-bars rise up or disappear with considerable frequency. Without a proper notation of these things, navigation would be unsafe and insurance rates would be high.

Nor is this all. Marine architecture is progressing, and with that progress ships are growing longer, their waist-lines are getting broader, and their drafts are becoming deeper. In 1848 the loaded draft of the 20 largest ships in the world averaged 19 feet. In 1873 the average of the 20 largest ships was 24 feet, while even in 1898 the average of the 20 largest was only 29 feet. The length of the 20 largest ships in the world rose from an average of 390 feet in 1873 to 640 feet in 1903. It is obvious that a survey thorough enough to meet conditions in 1873 would be wholly insufficient to meet conditions in 1914.

Once a rock that was 25 feet below mean low water was of no interest to navigators; today three-fourths of our navy and half of our shipping would be in danger with such rocks uncharted. There are thousands of rocks dotting the under-water sections of our harbors and shore-lines that could be neglected 20 years ago, but which today are great men-

aces to navigation until they are located and marked on the sailing charts. For instance, the new super-dreadnought New York today would run aground in a thousand places along the Atlantic coast where the Oregon could navigate with impunity in the day when it was the crack ship of the American navy; thus the Coast and Geodetic Survey must always go deeper with its investigation of the bottom of navigable waters as the draft of ships increases.

A MARINER'S PICTURE-BOOK

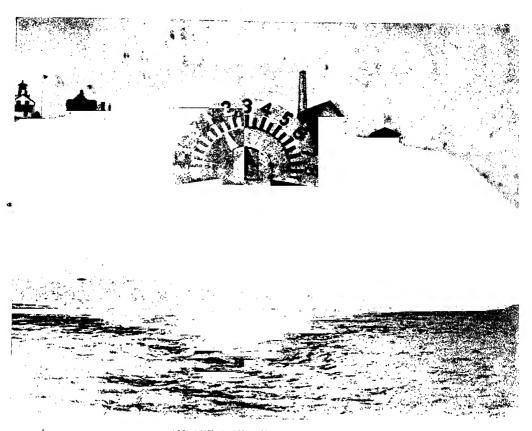
In short, the object of the coast survey is to make a series of map pictures by which navigators may read every detail of coastal or harbor conditions that will enable them to steer clear of all dangers. These pictures must carry to the eye of the mariner every feature of the shoreline, every important feature of the bottom over which his ship has occasion to pass, as well as that over which dangers forbid it to pass, and every detail of current, tide, and compass behavior that enables the mariner to keep in safe waters and out of dangerous channels.

On the map are located all the physical features of the neighborhood—its high-water line, its low-water line, its offlying rocks, its streams, the elevations of its hills, its towns, roads, lighthouses, aids to navigation, church spires, tall chimneys, peculiar rocks and trees, and the like.

MAKING THE SOUNDINGS

In ascertaining the depth of the water and locating all the under-water obstructions to navigation, a careful record of the fluctuations of the tide while the soundings are being made must be kept. It would not suffice to measure the depth of the water if its height above mean low sea-level were unknown for the moment of measurement. To determine this a registering tide gauge is used—a sort of float attached to a mechanism in which a pen traces the rise and the fall of the water on a roll of paper which a clock causes to revolve under the pen.

Two methods of sounding are used, the one employing the lead line and the other the wire sweep. In lead-line soundings



AN AUTOMATIC TIDAL INDICATOR

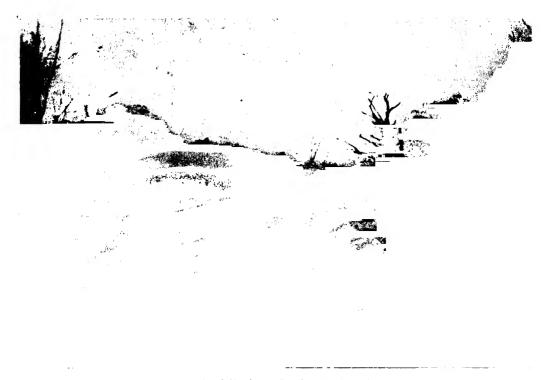
This purely American aid to navigation automatically shows the height of the water at any moment. When the arrows point upward the tide is rising; when downward, it is falling. The index on the scale shows that at the moment when the photograph was taken there was an excess of 11/2 feet above the normal level of the water.

the process is about as follows: A party goes out in a rowboat or launch, among its members being two observers with sextants and a map showing the shoreline and the objects whose positions have been determined by triangulation; a recorder with a clock and record book; a leadsman and a steersman. The officer in charge directs the recorder to make a note of the position of the boat, which is determined by the observers, and the leadsman casts his line and calls out the depth in feet or fathoms as he draws it up. The recorder makes a note of this and also of the course along which the boat is headed. At intervals of a minute or more the leadsman casts his lead, while every three or four minutes the observers take observations until the end

of the course is reached, where a final set of observations locate the end of the The boat then turns and runs other lines in the same way, until the entire bottom of the surveyed area has

been sounded (see page 657).

The resulting figures must be corrected so that they will all apply to what is known as "mean low water." fixed by taking the sum of the low-water readings for perhaps thirty days and finding their average. In fixing the depth of a sounding, the time the sounding was taken is noted and deductions or additions are made to conform with the state of the tide at that hour, as shown on the tide gauge sheets, so that all soundings are recorded on the chart as if made at "mean low water." On



ONE OF THE JOYS OF SURVEYING

Using a sled and four bullocks to transport instruments to the triangulation station at White Rock, Virginia, which was situated in the mountains, miles from the railroad and approached by no road.

the Pacific coast, and in Hawaii, the Philippines, and Alaska the datum is lower, being "mean lower low water."

THE WIRE DRAG

The lead-line method of sounding suffices to record the lay of the bottom with sufficient accuracy where there are no extraordinary obstructions; but in a region like the coast of Maine and that of Alaska, where there are many isolated pinnacle rocks and ledges under water, or along shores like those of Florida, Porto Rico, and the Philippines, where coral reefs abound and coral heads fringe the coast, special investigations have to be made. The lead line might be cast all around a pinnacle rock—night even strike it a giancing blow—and still fail to discover it.

An instance of this kind occurred in Buzzard's Bay, Massachusetts, in 1902. Although more than 91,000 soundings had been made, more than 16,000 angles

observed, and 1,462 miles of sounding lines run, a rock whose head was 18 feet below the surface was run upon by the cruiser *Brooklyn* during the naval maneuvers of that year.

In order to discover such obstructions in much frequented waters a new instrument, the wire drag, has been devised. It consists of a long wire, sometimes more than a mile long, weighted down at intervals with sinkers and supported at any desired depth by surface buoys. Several power-boats are hitched to it, usually one at each end and one in the middle, and with these it is drawn around a harbor much as a farmer drives his binder around his field of standing wheat. If it strikes no obstruction the hydrographers know that the harbor bottom is clear to the depth of the drag (see page 656).

Another line of information the mariner must have is about the movement of currents, so that his ship may not be



A PLANE-TABLE SURVEYOR MAPPING A SECTION OF SHORE-LINE

In making a survey of a harbor or section of shore-line, it is necessary to prepare a topographic map of the surrounding territory, showing all objects in the landscape that will help the nawigator to fix his position (see page 658).

carried around by currents whose presence he does not suspect. Information concerning them is gathered by means of current rods, as a rule. A current rod is an instrument made to float vertically beneath the water, with only its tip showing above the surface, so that it is not disturbed by the wind. Its movement is observed, and the observations give definite information concerning the currents.

MAKING THE CHART

When all the work in the field has been finished, including observations which show the deflection of the magnetic needle, the force goes back to head-quarters and begins the task of "writing up" its notes. And a bunch of notes they are to be written up! To make a single chart of a single harbor may require as many as 12 sheets of field hydrographic drawings, 16 sheets of field topographic drawings, 57 volumes of soundings, 22 volumes of tidal records, 20 volumes of trigonometric rec-

ords, 7 volumes of altitude records, and 8 volumes of magnetic records.

Obviously the proposed chart cannot be as big as the area it is to represent, so the first thing to be determined is the scale to which it is to be drawn. In representing a harbor the usual scale is approximately half a foot to the mile, or exactly one foot to ten thousand feet. For ordinary navigation along the shore, where ships keep outside the 100-fathom line, a foot on the chart may represent nearly 80 miles, or, to be exact, 400,000 feet. On charts used to approach the coast the usual scale is about a foot to 16 miles, or one foot to 80,000, to be exact again. In all cases a foot on the chart represents just as great a distance on the land or on the water as a clear exposition of the facts to be placed on the chart will permit.

After the map is drawn it is reproduced either on copper plates or on aluminum plates. By photography a copy is made from the drawing, and this is laid down on the copper to fit the latitude and



MEASURING A BASE-LINE

In all Coast and Geodetic Survey work the accurately fixed and measured base-line is the foundation upon which everything else rests. It is measured by the use of invar tapes, which are almost wholly unaffected by heat or cold. The tape is stretched under a uniform tension, hence the spring balance in the picture. The marks for each tape-length are made in hardwood posts firmly set in the ground (see page 665).

longitude marks. The impression is then chemically fixed on the plate, and the engraver, who must have a high degree of skill and accuracy, proceeds to work. The figures showing the depth of the water at each point are put on the plates by a machine, one man being able to do with the machine the work of several by hand, cutting uniform figures and putting them in with mechanical accuracy.

Printing from copper plates is a laborious process. The ink is first placed on the plate and then wiped off with the palms of the hands of the operator and his assistant, leaving only a tiny bit adhering in the engraved lines. It is then run through the press, in contact with wetted paper, after which the prints are calendered by being subjected to a pressure of 600 tons in a hydraulic press.

For cheaper and more rapid work aluminum plates, coupled with the lithographic process, are used. A drawing is made on tracing vellum and then photographed on a sensitized glass plate. Positive plates are made from these negatives, and from these are transferred to the aluminum plates, which have been substituted for stones in the lithographic process. One of the old stones weighed 640 pounds and cost \$185; the aluminum plates weigh 5 pounds and cost \$4.50.

All the original information upon which every chart is made is filed away, and if one little detail were found wrong to years' later the very man who made the error could be located.

100,000 CHARTS ARE DISTRIBUTED EACH YEAR

The vast importance of the hydrographic work of the Coast and Geodetic Survey is illustrated by insurance rates in harbors where it has done its work and in those in which it has done nothing. In Nome, Alaska, for instance, the marine insurance rate is five-eighths of one per cent, the harbor being surveyed. At Kuskokwin, Alaska, the rate is from 1½ per cent to 5 per cent, with the agents not eager for business even at such rates.

The charts of the Survey are kept on sale at all times, and are sold at a price which covers only the cost of the paper and the actual printing. They are fur-

nished to all the ships of the American navy, and the chart-room of one of the big superdreadnoughts contains a series of cabinets where the charts are always kept, ready for reference at a moment's notice. The Hydrographic Office furnishes the same kind of charts for foreign coasts that the Coast and Geodetic Survey furnishes for home coasts.

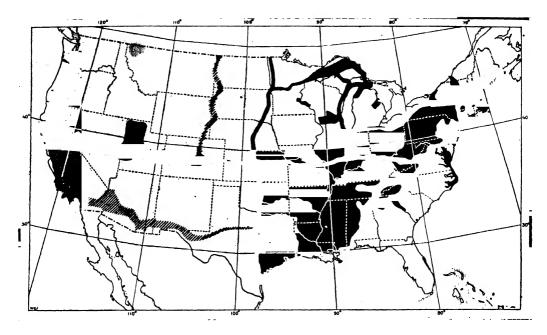
Nearly a thousand different charts have been prepared of the coasts of the United States and its outlying possessions since the Coast Survey was organized. These range in importance from the great charts of New York harbor, where billions of dollars worth of commerce and millions of lives are safeguarded every year, to the charts of places in Alaska, where a ship may not be seen more than once a week, or even once a month. The charts are in great demand by navigators at home and abroad, and the annual sale amounts to more than a hundred thousand copies.

ASTONISHING PRECISION

The geodetic work of the Coast and Geodetic Survey forms a fascinating part of its activities when one looks behind the mathematics involved. It deals with conditions that very many people do not know exist, and requires measurements of a refinement that must eliminate even the personal equation.

When work must be so accurate that it requires the elimination of the difference of the speed with which the eye telegraphs to the brain and the brain to the hand, in two men; when it must be so exact that a line a mile long may turn to the one hand or to the other no more than 1/33 of an inch; when it must reach that standard when the average error is less than one inch in 500 miles in leveling work, it is apparent that the most delicate instruments and the most refined measurements are required. Yet such is the standard set by the Coast and Geodetic Survey for its finest surveys.

It determines the longitude of a place by use of a transit instrument and the telegraph—the transit instrument showing to 1/500 of a second the exact moment at which certain stars cross the meridian of the place, and the telegraph



MAP SHOWING THE NETWORK OF PRIMARY TRIANGULATION IN THE UNITED STATES,
ABOUT 10,000 LINEAR MILES BY THE COAST AND GEODETIC SURVEY AND
ABOUT 2,000 MILES BY THE LAKE SURVEY

The Texas-California arc, indicated by shading in the lower left-hand portion of the illustration, and the one hundred and fourth meridian arc, similarly shown in the upper portion of the illustration, between the one hundredth and one hundred and tenth meridians, are the most recently completed of the larger arc. The former extends from central Texas to the Pacific coast, is 1,220 miles in length, covers an area of approximately 48,400 square miles, and determines the geographic positions of more than two hundred monumented stations and permanent objects. Connections were made with monuments of the international boundary between this country and Mexico and stations of detached triangulation by the United States Geological Survey.

Primary triangulation is necessary as a framework for coördinating and placing on a single basis all maps and charts made by the Federal and State governments. Monuments of a number of State boundaries are already connected with the triangulation net, and should they and all other evidence of the boundaries be destroyed, it is possible to replace them within a very few feet. It is planned to extend this triangulation until no place in the country is more than one or two hundred miles from a station. Intermediate areas will be controlled by triangulation of a lower order. In addition to the primary, there are many thousands of miles of secondary and tertiary triangulation along the coasts and inland, which furnish the immediate control of charts and maps (see also pages 663-665).

showing the time when they cross the meridian of a place of known longitude. A simple calculation, then, shows the difference of longitude of known and the unknown positions.

The latitude of a place is fixed also by observing the stars, when the Survey does its finest work. With a zenith telescope it notes the exact time when a pair of stars culminate, and after making allowances for refraction, temperature, and the like the determination becomes merely a mathematical one.

In making a survey, after the longitude and latitude of the starting point has been ascertained, a base-line is laid out. Its direction, with reference to the meridian of its starting point, is fixed with great accuracy; the line must not turn to the one side or to the other more than 1/33of an inch to the mile. The instrument with which this determination is made is known as the theodolite, and consists of a small telescope mounted on a horizontal graduated circle. The lines on this circle are so finely engraved as to be invisible to the naked eye, and the operator reads each measurement by three different microscopes of high power, each of which must tell him identically the same story. Furthermore, he repeats this process of measuring and reading many times, so as to make sure he has avoided mistakes.

The length of the base-line is fixed as accurately as its direction, else all the work that follows would have no value of exactness. In the past these lines were measured with various kinds of apparatus, their accuracy being checked by comparison with a five-meter bar. bar was a little more than five meters long, but the measuring part of it was the distance between two lines, invisible to the unaided eye, engraved upon iridium plugs inset in its surface. While in use, the bar was kept at a constant temperature by melting ice packed around it. The trough supporting the bar was mounted on a carriage moving upon a track built for the purpose. The successive positions of the ends of the bar were determined by high-powered microscopes firmly attached to heavy posts solidly planted in the ground.

This method, slow and expensive, even

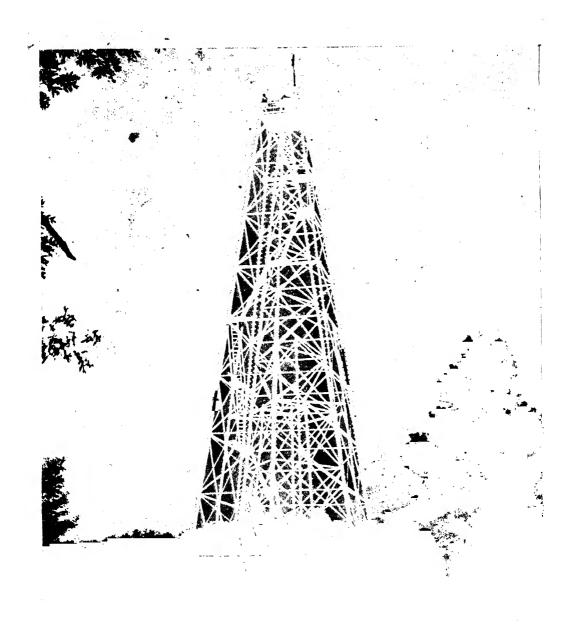
when used to check the work of simpler apparatus, has in late years given place to the invar-tape method. Invar tapes are made of an alloy of nickel and steel, and their lengths are practically exempt from the influences of heat and cold. They are used in connection with spring balances, which determine the amount of tension on the tape at the moment of measurement. This method is as cheap as it is accurate and permits much more frequent base-lines, and therefore there is less liability to error (see page 062).

DIFFICULTIES OF THE WORK

The position of the starting point determined, the length and direction of the base-line measured, the distances between hundreds of other points are fixed The surveyors take by triangulation. one line of known length, and from its two ends observe two other directions to a common meeting point, thus making a triangle. By measuring the angles of the triangle they can determine the distance between the two ends of the base line and the third point more rapidly than if they had taken a standard meter-bar packed in melting ice and laboriously measured the entire distance up hill and down dale, across river and over mountain peak.

In some of the triangulation in mountainous country the lines joining adjacent stations are frequently as much as a hundred miles long, and for such distances special signals have been devised. In daylight observations are made on the heliotrope, a reflecting mirror which reflects the rays of the sun to great distances. The most satisfactory signal, however, is a high-powered automobile headlight used at night. Some of these lamps in the atmosphere of Arizona have shown distinctly through the telescope of the theodolite over a distance of 120 miles (see page 669).

In triangulation work high mountains are desirable, as they more than atone for the difficulty involved in scaling them by the great area of country they spread before the observer. When work is done on level or nearly level ground or in heavily wooded country, it is necessary



A TRIANGULATION STATION

When doing triangulation work in a level or wooded country, it is sometimes necessary to build a high tower that will bring the observers above the trees and buildings of the neighborhood and afford them an unobstructed view of other towers or natural objects in the distant landscape. On the coast of Washington a crow's-nest was built on a tree-top and an elevation of 215 feet was secured.

to build high towers if the distance be long and to overtop the trees if they interfere. In a perfectly level country, with a line of 20 miles, the towers must be 60 feet high to overcome the curvature of the earth and to make the line clear between the light and the theodolite.

THE GREAT ARCS OF TRIANGULATION

The progress of the Coast and Geodetic Survey is graphically shown in the map on page 664, which reveals the fact that a band of triangulation has been stretched from the frontier of Maine along the coast to the mouth of the Rio Grande, Here a line has been run due north to the Canadian border. where it intersects with the boundary between North Dakota and From this arc, at a Minnesota point not far west of Fort Worth, a line swings westward to the California coast and thence to Puget Sound, and thence along the Canadian boundary to the line extending north from the mouth of the Rio Grande.

Another great line cuts across the country from San Francisco due east to the Blue Ridge and Allegheny Mountains, where it intersects another line running from the Maryland line to Mobile, Alabama This latter line has a greatly extended area in the vicinity of the approximate juncture of the boundaries of Tennessee, North Carolina, Alabama, and Georgia. A shortline has also been run across the northern neck of Florida, one up the Mississippi, one from a point south of Denver to the Canadian line, and one from the North Dakota-South Dakota-Minnesota intersection to the western shore of Lake Superior.

In addition to these, there are a number of disconnected surveys here and there over the country and a number of reconnaissances or preliminary surveys. Upon these lines of triangulation are based all the exact knowledge we have concerning the exact location of surface of the United States as a geographic entity.



THE GREAT CASPAR SIGNAL

When surveying in Mendocino County, California a signal tower was built round a great tree, the trunk of which was used to support the top of the tower and in this way the instruments were elevated to the height of 135 feet above the ground.



THE METAL DISCS WITH WHICH THE COAST AND GEODETIC SURVEY MARKS ITS TRIANGULATION STATIONS

Each triangulation is marked by brass and iron discs as shown in the picture. These marks are useful not only to members of the Survey who desire to relocate positions, but also to private surveyors who desire to connect their survey with one of these control points.

Every survey must have a beginning, and the beginning point of the great national triangulation survey is a point in Kansas formerly known as the United States Datum, but now as the North American Datum. All surveyors' lines in the United States eventually will lead from here, as all roads led to Rome in a bygone civilization. Canada and Mexico have adopted the North American Datum, so that practically the whole of North America which has been connected trigonometrically is hitched to this point.

So carefully have all the different surveys been made that they may all be put together and the lines fit perfectly. Any one familiar with surveys made on each side of a river, and how hard it is to get them to fit together, in ordinary practice, can understand what accuracy has been required to bring all the different surveys of North America into such harmony that from every point already fixed a skilled man from the Coast and Geodetic Survey could run his line right back to the North American Datum, in Kansas.

Of late years many cities have found it necessary to order a triangulation of their territory, in order to connect their surveys with those of the Coast and Geodetic Survey. There was much confusion encountered in the offices of city surveyors in trying to connect their layouts of streets, lots, parks, and other works and areas with the big federal survey. These triangulations cover such cities as New York, St. Louis, and Boston, and are now in progress in San Francisco and Cincinnati. Maryland has had all her oyster beds located by the United States triangulation surveys and their positions fixed with reference to the United States Datum and the stars.

DETERMINING THE EARTH'S SHAPE

The work of the Survey in measuring with great accuracy the surface of the United States has not only had its practical uses, but its scientific uses as well. The diameter of the earth is the primary yardstick by which all celestial distances are measured, and the exact length of this astronomical yardstick cannot be known until the shape of the earth is determined with great accuracy. So important is this work that 21 nations are linked together in an international agreement for the support of the International Geodetic Association and the promotion of its work of earth-measurement. central bureau is maintained at Telegraphenberg, Prussia, and triennial conferences of the science of geodesy are held.

The work of the Coast and Geodetic



ONE OF THE POWERFUL LIGHTS WHICH FLASH SIGNALS IOO MILES

These signals are used to flash from one triangulation station to another making observations at night. The lamps are lighted by acetylene gas, and the reflectors are so powerful that the light has been seen through the telescope of a theodolite for a distance of over 100 miles (see page 665).

Survey has proven so accurate that the world now recognizes the figure of the earth determined by it as the best available, and for that reason it was adopted as the standard by the International Convention of Astronomers, recently held at Paris.

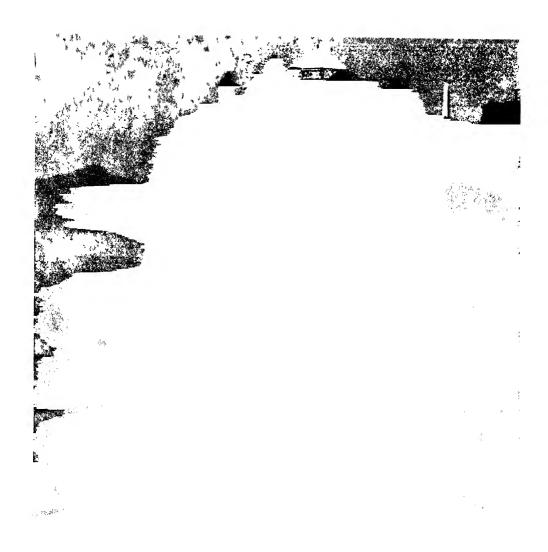
MAPPING WITH CAMERAS

In recent years the Survey has been employing the camera in making its topographic surveys, thus being able in some instances to do away with the plane table. This method of topographic surveying is especially useful in such regions as Alaska, where difficult country and bad weather conspire against the successful use of the plane table. The cameras are specially prepared, cross wires being fixed to the lens and the scale being so arranged that they appear with the view upon the photographic plate. The chief

precaution necessary is that each prominent topographic object shall be photographed from at least two points (see page 674).

The work of triangulation and precise leveling sometimes requires the endurance of great hardships and affords many adventures. These involve all the dangers and experiences that go with scaling the Alps or climbing a Mt. McKinley. Tugging instruments up a mountain-side, where the slightest misstep would carry the bearer to the bottom of some terrible chasm or precipitate him into some madly rushing, ice-cold mountain stream, is no summer-evening picnic at best.

Now one of the Survey engineers may be heading a party on the 141st meridian that divides Alaska from Canada, where today they scale a great mountain peak within the Arctic Circle, tomorrow battle



SURVEYING FROM A MOUNTAIN TOP

In making a geodetic survey, absolutely flat country is a much greater obstacle to the surveyor than a range of mountains. Indeed, a high mountain, commanding extensive views in all directions, is often a godsend, as it may serve as the apex for triangles drawn in all directions. Here is such a mountain, Uncompahere Peak, on the summit of which, 14,289 feet above the sea, a triangulation station was erected when surveying the Colorado arc (see page 665).

with an epidemic of smallpox among the Eskimos, and a few days later are down in a little valley where the mosquitoes are so thick that even a horse cannot graze unless it be protected by nets. Now one of them is at work with a party in the Rocky Mountains, fording streams that are bordered with quicksands, shooting down rapids that threaten every moment to swamp canoe, party and all.

But whatever the task of the men, they learn to live with the thought uppermost in their minds that he who is willing to bear the heaviest burden will find every other member of the party ready to help

him bear it.

Men go to Africa to hunt big game; they go to South America to explore new rivers; they go to Switzerland to climb high mountains; they go to the heart of Africa and the interior of Tibet to find strange people; but the men who make the basic surveys upon which our knowledge of the shape of the earth and our maps are based get all the thrills and all the experiences that come to them all, and get back to Washington safe and sound and ready for the prosaic work of writing up their notes.

A MAGNETIC SURVEY

Accurate surveying such as is involved in the triangulation work of the Coast and Geodetic Survey would not boot much on land or sea were definite information not at hand concerning the behavior of the magnetic needle. The magnetic needle refuses to stay put anywhere, and varies from the true north in different degrees in different parts of the earth. For instance, in London it changed its direction 35 degrees in the 232 years preceding the outbreak of the War of 1812. Then it began to swing back again, and up to the present time has moved east nearly 10 degrees. The change is by no means as rapid in the United States as it is in London, but at the same time it is enough to interfere with every survey if the rate of change were not known. As the rate varies between London and Washington, so it varies in different parts of the United States.

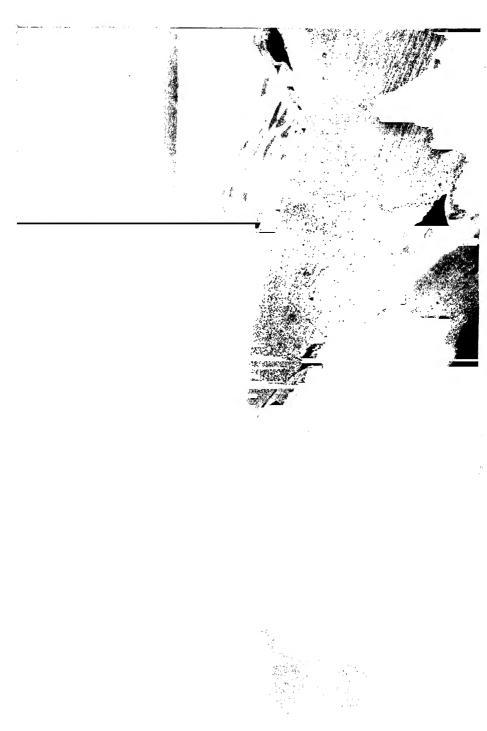
In order to determine the declination of the magnetic needle innumerable ob-

servations have been made all over the United States, and the exact declination for each place has been ascertained. In the section east of the Rocky Mountain States there is scarcely an area 50 miles square where the variation of the needle has not been measured and passed on to the State and local surveyors, and in few places are these points of needle observation more than 20 or 30 miles apart. The method by which the variation at a given point is found is to compare the north of the compass needle with the true north revealed by the theodolite. The difference is the variation of the needle.

THE MAGNETIC NEEDLE IS NEVER STILL

If the behavior of the needle is important on land, it is even more so on the A boundary a mile long fixed by the compass in Maryland in 1802 would now have its one end some 525 feet away from the original location if the survey now did not allow for the change in the variation of the compass since 1802. But on land points can be located without the use of the compass. On sea the compass is yet indispensable, and the navigator must constantly allow for its continual changes, else some fine night he would find himself high and dry on a reef when he thought he was miles away from it. For instance, the declination of the compass at Key West is 2 degrees east, while at New York it is 10 degrees Did a skipper steer through his voyage from Key West to New York on the assumption that the declination was the same at New York as at Key West, he would run into the coast somewhere south of a point 19 miles west of New York.

The Survey maintains observatories at Cheltenham, Maryland; Baldwin, Kansas; Sitka, Alaska; Vieques, Porto Rico, and near Honolulu, Hawaii, where the behavior of the magnetic needle is under constant observation and study. There are places where the compass needle varies from forenoon to afternoon enough to make a difference of from 5 to 20 feet in a mile-long line, and places where there have been sudden and unaccountable changes such as occurred



SURVEYING UNDER DIFFICULTIES IN ALASKA

This picture gives an idea of some of the difficulties encountered by the surveyor. To obtain the necessary elevation the instrument had to be taken to the top of a snow-clad mountain peak, which was so small that it hardly afforded room for the instrument and the two observers

at Los Angeles during a violent storm, when the needle shifted more than 1\frac{1}{3} degrees in a few hours. All these phenomena are carefully studied in the hope of discovering ultimately the secrets of magnetism.

A magnetic map of the United States is made showing the lines of equal magnetic declination and those of equal dip. For instance, the map for 1905 shows that 5 degrees east declination runs almost due north and south, while 10 degrees east crosses the Canadian boundary near the Lake of the Woods, Minnesota, and swings around to the south west, reaching the Pacific Ocean across Lower California. The 70-degree line starts in in the neighborhood of the southern Delaware boundary, and sweeps through northern Virginia, southern Ohio, and middle Nebraska, reaching the Pacific through southern Washing-

The magnetic map is always changing, but the information is carried with it which enables the mariner or the surveyor to make the necessary corrections at any given point.

PRECISE LEVELING

The United States Coast and Geodetic Survey has established precise levels in every section of the United States, marking the altitude at convenient points by means of bench-marks. These mass are the beginning points of all local surveys, such as are necessary in railroad location, water-works planning, and the like. The maximum error allowed in this work is one-fifth of an inch to the mile. In recent years a large number of long circuits have been made, and where these are closed the maximum error has been about one five-hundredths of an inch to the mile. This applies to the precise leveling of over 4,000 miles of line.

Precise leveling is now done with a spirit-level attached to a telescope designed and made by the Survey itself. By the use of a nickel-iron alloy changes due to temperature conditions are practically eliminated. One of the officers of the Survey declared that he could take one of these levels, put it into the hands

of the youngest engineer in the Survey, and get better results than the best engineer the American Society of Civil Engineers could get with any other level. After inspecting the Coast and Geodetic level the challenge was not accepted. Many other countries have adopted this instrument in all their leveling operations (see page 675).

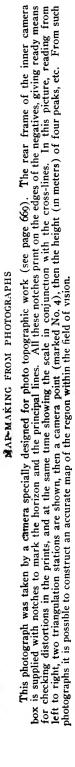
Some leveling is done by the measurement of vertical angles, although this system is not regarded as accurate enough for the finest work of the Survey

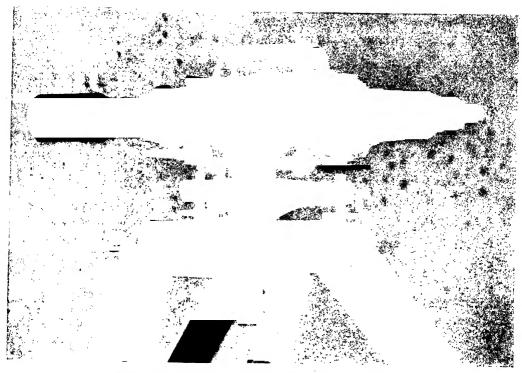
THE TIDES

In addition to its other work the Coast and Geodetic Survey keeps the records of the tides, and furnishes tables which show the fluctuations for every hour and every day for as much as a year ahead. The Survey has made a great mechanical prophet that can predict the recurrence of tides as accurately and as unerringly as an astronomer can predict the coming of a solar eclipse. Its brain of brass can, with the aid of one man, calculate the recurring tides as rapidly as a hundred brains of flesh and blood can do it (see page 676).

The machine is known as "United States Tide Predicting Machine No. 2." The operator turns a crank until it stops. He then copies the readings on a number of dials and removes from the machine a roll of paper on which is plotted a tidal curve. This process is repeated until tide-tables have been prepared, showing the height to the nearest tenth of a foot of every high and every low tide at a given seaport for every day in the year. This is repeated for some seventy big seaports and in less complete form for 3,000 others.

There are 37 factors in the making of tides, sometimes all of them entering into the process and sometimes fewer of them. We know that they are produced by the force of gravity between the earth, the sun, and the moon, and the tide-predicting machine is simply a mechanism that brings these bodies into their proper relations for every hour and every day of the year, and automatically computes the effect of these relations on the tides and registers it on the dials.





THE MOST PERFECT PRECISE LEVEL IN THE WORLD

This level was designed and made by the Coast and Geodetic Survey and is recognized by engineers as being superior to every other known make. It can produce more rapid and efficient work for a less cost than any other type. It has been officially adopted not only by the government of the United States, but also by those of India, Mexico, Canada, and Egypt (see page 673).

We say that it is simply a mechanism that does these things; but when it is remembered that the machine has 15,000 parts, and that 15 years of careful work were required in its construction, we understand that it is not very simple after all.

The records made by this machine are used wherever men sail the seas, and as the question of a foot or two in depth on a dangerous shoal may involve the lives and the property on a passing ship, while the commercial prosperity of a port may depend upon information about the tides, this great machine serves more than a theoretical purpose. Its tabulations do for the waters what the American Ephemeris and Nautical Almanac does for the stars in aiding navigators.

THE WONDER OF THE TIDES

The tides are among the most remarkable phenomena in the world of nature,

and they give rise to many peculiar notions concerning the level of the oceans. The tide at Panama, for instance, rises much higher than the tide at Colon, and this leads many people to think that the Pacific has a higher level than the At-As a matter of fact, however, while the tidal fluctuations on the Atlantic side have a range about 2 feet and those on the Pacific side a range of about 20 feet, the level of the oceans is the The difference is caused by the narrowing shoreline of Panama Bay, which takes a broad expanse of water as it enters the bay and narrows it down as it sweeps into the V-shaped entrance. What it loses in breadth it must make up in depth, and hence the higher tides on the Pacific side of the Isthmus at Panama.

The same phenomenon is witnessed in the Bay of Fundy, where at the head of



A MACHINE THAT PROPILESIES

This machine—the only one of its kind in the world—will predict the tides at any seaport as much as 100 years in advance. It is used in the compilation of the tide tables issued each year by the Coast and Geodetic Survey. A simple turn of the handle will record on the dials the time and height of the water at high or low tide for each day in the year at any selected port, and at the same time trace a tide curve which forms a permanent record of its predictions. The machine—an improvement of Lord Kelvin's tide-curve machine—was designed and constructed by the Coast and Geodetic Survey and is a triumph of applied science.

the bay the rise is 55 feet above sealevel. At spring tides the water in the Bay of Fundy is 19 feet higher than in the Bay of Verte, only 15 miles distant.

The mechanical division of the Survev is a wonderful place to visit, as may be inferred from the fact that it can make theodolites so accurate that in the triangulation between the Maryland and Georgia base-lines the discrepancy was less than half an inch in 30 miles, and that it can make precise levels so accurate that the maximum error is an inch to 500 miles. In addition to the marvelous tide-predicting machine, it has a circular dividing engine with which it constructs the scales on the graduated circles. This engine has a spindle 4 inches in diameter, tapering three-quarters of an inch to the foot. This spindle must fit into its bearing so nicely that it has less than 1/10.000 of an inch play. Before the dividing engine can be set to

work the room must have been subjected to a uniform heat for several days, in order that every part of the walls may be uniformly warm, so as to prevent aircurrents from interfering with the accuracy of the work. The room is kept at blood heat, so that the presence of the supervisors of the engine's operations do not interfere with its accuracy.

The Coast and Geodetic Survey was founded in 1807 under President Jefferson, and was then known as the Coast Survey. Its greatest work dates from 1878, when it was broadened to its present scope. Today it employs 700 men, and has become one of the Federal government's most important bureaus, serving well the practical needs of every-day life, and at the same time pioneering in paths of science in a way that has added and is adding to the fund of human knowledge on the subjects with which its investigations deal.

HONORS TO COLONEL GOETHALS

The Presentation, by President Woodrow Wilson, of the National Geographic Society Special Gold Medal, and Addresses by Secretary of State Bryan, the French Ambassador, the German Ambassador, and Congressman James R. Mann

HE ninth annual banquet of the National Geographic Society was held at the New Willard Hotel, Washington, D. C., on the evening of March 3, 1914, and was made the occasion of the Society's formal recognition of the eminent services of Col. George W. Goethals, U. S. A., to geography and to the world as the builder of the Panama Canal.

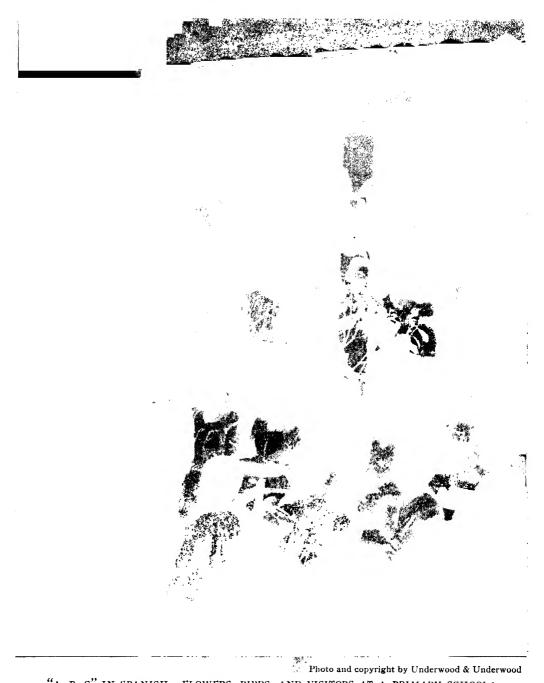
Among the members of the Society and guests present, numbering more than 800, were the President of the United States, with a majority of the members of his Cabinet—Secretary of State Bryan, Secretary of the Interior Lane, Secretary of the Treasury McAdoo, Secretary of Agriculture Houston, Secretary of the Navy Daniels, Secretary of War Garrison, Secretary of Labor Wilson; members of the Supreme Court, Senators and Representatives from nearly every State, diplomatic

representatives of every great foreign nation, officers of the Army and Navy, and men and women prominent in the world of science and letters.

The tables were arranged in the form of a huge gridiron and the banquet hall beautifully decorated with flowers and flags. Behind the speakers' table, high overhead, there was a great blaze of electric lights spelling the union of the oceans and the completion of the canal in the words

ATLANTIC—GOETHALS—PACIFIC

The tributes which were paid to the guest of honor by the speakers of the evening were enthusiastically received by the vast audience. Colonel Goethals was accorded an honor which has been achieved by few men—the distinction of receiving at the hands of the President of the United States a gold medal in



"A, B, C" IN SPANISH—FLOWERS, BIRDS, AND VISITORS AT A PRIMARY SCHOOL: JALAPA, MEXICO

While the children of the peons seldom go to school, either because of indifference to the advantages of education or lack of school facilities, the children of the well-to-do enjoy educational advantages equal to those of other countries.

recognition of his services to his country and the world.

President Wilson's presentation speech conveyed to the great engineer the thanks of the nation, and when he said that the name of Goethals was now written where only the wiping out of our present civilization could cause it to be forgotten, and called upon him to rise and receive the highest honor in the gift of the National Geographic Society, the outburst of applause which swept over the vast audience almost drowned the voice of Colonel Goethals as he tried to find words in which to voice his appreciation of the honor done him.

It was plain that he felt more at home "dividing the land and uniting the world" at Panama than he did in receiving a medal in recognition of his work.

Every speaker of the evening lauded the work of the Americans at Panama and praised the men to whom the world owes the canal.

Before presenting the French Ambassador, Mr. J. J. Jusserand, the Toastmaster, Secretary Bryan, announced his election as an Honorary Member of the National Geographic Society, "for the double reason that his nation deserves a part in this great undertaking, and because of the personal interest that he has always manifested in the work of this Society."

At the end of the speaking Secretary Bryan, the Toastmaster, proposed a toast to the wife who had stood by her husband so loyally during the long and trying siege of work that had been his lot at Panama.

The special medal of the Society is made of heavy Roman gold and bears the following inscription:

"This special medal of the National Geographic Society is awarded to George Washington Goethals, to whose ability and patriotism the world owes the construction of the Panama Canal, March 3, 1014."

A special medal of the National Geographic Society has been awarded only twice before—to Robert E. Peary, December 15, 1909, "for the discovery of the North Pole, April 6, 1909," and to Roald Amundsen, January 11, 1913, "for

his Antarctic achievements, resulting in the attainment of the South Pole, December 14, 1911."

ADDRESS BY DIRECTOR GROSVENOR

Mr. President, Members of the National Geographic Society:

Owing to the sudden, but not serious, illness of our learned and loved President, Dr. Henry Gannett, and also to the illness of our Vice-President, Dr. Tittmann, the duty of welcoming you here this evening has unexpectedly come to me at the last moment.

On behalf of the Society, I express our very deep appreciation of the fact that the President of the United States, Hon. Woodrow Wilson, whom we all most devotedly serve, has by his presence honored the tribute which we are giving to the man whose genius built the Panama Canal.

Before introducing the Toastmaster of the evening, I ask your indulgence for a few moments while I read a few statistics about the work of the National Geographic Society. The 12 months since we last met in this hall have made the most successful year in the history of the National Geographic Society. Seventy-four thousand new members have been added to the enrollment, making the total present membership of the society two hundred and sixty-one thousand.*

These are distributed in sixteen thousand towns, villages, and hamlets in the United States and in two thousand cities in foreign countries. California in proportion to its population is our banner State, with a membership of twenty-five thousand. New York City leads our cities, with an enrollment of nineteen thousand. There is not a community of one hundred white people in the United States where a member of our Society cannot be found.

The explorations and educational work of the Society during the past year have kept pace with the increase in membership. We have been continuing our researches in Alaska, in Peru, and elsewhere

Our Magazine has become perhaps the greatest educational journal in the world.

*The membership on June 15, 1914, is 280,000.

It reaches thousands of schools and libraries and is inducing more than one million people each month to read of geographic matters. One month's edition, if the copies were placed one above another, would make fifteen piles as high as the Washington Monument, or, if placed on a book-shelf, would reach from the White House to the Capitol and back again. The Magazine yields the funds to pay for our exploration; for, unlike other scientific societies, our Magazine supports the Society instead of being a drain upon the organization.

These figures are given that all here may appreciate that the ambition of the Society to increase and diffuse geographic knowledge and help the cause of international good-will is being realized.

Through our Magazine we are bringing our citizens nearer to other peoples and also bringing other peoples nearer to us

It is now my privilege to present one of the most distinguished members of our Society, 11on. William Jennings Bryan, the Secretary of State, who will direct the proceedings of the evening.

THE TOASTM ISTER, WILLIAM JENNINGS BRYAN, SECRETARY OF STATE

The task of a Toastmaster is always the easiest on the program and easier tonight than it usually is, because those who are to speak to you do not require to be presented with an elaborate explanation. Especially is that true of those who appear as the first and second.

A medal given by this Society will be presented to the guest of the evening, and when the greatest Geographic Society of the world is to honor the most illustrious member of his professon on the globe, because of the successful completion of the most gigantic engineering feat in history, there is but one person to present the medal, the President of the United States.

ADDRESS BY PRESIDENT WOODROW WILSON

I am now so unaccustomed to public speaking that it was with genuine hesitation on my own account that I accepted the invitation of this evening. But I accepted it as a matter of course when the great compliment was paid me of ex-

tending it to me, because it seemed to me that it was not only a personal privilege which was offered, but a duty encumbent upon me as a representative of the government of the United States. It seemed to me that, speaking for that government, as well as for the distinguished Society in whose name 1 am now presenting this medal, it was my duty as it was my privilege to be here.

I am here to do what I suppose is an unusual thing for a Society of this sort. It generally confers its honors upon those who have disclosed geography rather than upon those who have altered it. It is a sort of advertiser and custodian of the globe, and it is now about to honor a gentleman who has had the

audacity to change the globe.

The engineering profession is one of the few creative professions. Those of us who have attempted to be literary men conceive that we have created conceptions of the mind, but we never can produce them in court. They are never visibly upon exhibition. But the magic of the engineer is that he can change the face of nature and show the work of his hands, and that it is in some deep sense creative in character. The life of mankind on the globe is altered, for example, by the cutting and the use of the Panama Canal.

It fails the imagination to think what this work will accomplish. It will create new neighbors. It will generate new friendships; it will make a new atmosphere of rivalry and of generous asso-The whole tendency of the routes of trade will be changed, and the routes of trade are the routes of enlightenment. Only when nations touch one another do they cease to be provincial and look out upon the great tasks of humanity, instead of confining themselves to the relatively selfish tasks of their own domestic development, and it is only as we export and import ideas that civilization becomes thoroughly established.

We have, therefore, to honor tonight the greatest living representative of this

extraordinary profession.

It seems to me natural, if I may say so with apologies to some of our friends present, that the greatest engineer living should come from the United States.



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SELLING "HOT" PEPPERS—THE MEXICAN'S CHOICEST DELICACY: MARKET AT CORDOBA, MEXICO

"Hot food" with the Mexicans is more a matter of seasoning than of exposure to heat. Chili con carne and hot tamales have come with their fame to our own shores, but they are only two of the more than 57 varieties of "hot" things the Mexicans eat with evident relish and coming appetites. And "hot" penpers form the keynote of them?"



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A SPLENDIDLY EQUIPPED CARPET FACTORY OF SANTA GERTRUDE, NEAR ORIZABA, MEXICO

During the rule of Porfirio Diaz textile factories, employing thousands of laboring people, came into existence in Mexico. They were mostly owned by foreign capital, and through them a middle class was gradually being developed.

The United States has made the world very uncomfortable, but it has at least done so by the exercise of extraordinary dynamic qualities. It is not one of the statical nations of the world. It is one of the nations which has disturbed equilibriums, which has cut new paths for the thought and action of mankind.

And now there is to be elevated and kept always on high at this new gate, upon which men are to enter the roads of new experience, a name which will not be blotted out until and unless the whole civilization of the world should change, the name of Colonel Goethals.

The government of the United States lent him to the world, and he has done this thing for the world, for it is our proud boast that we have cut this highway for all the sea-going ships of the world.

GAILLARD, GORGAS, SIBERT, HODGES

I take it for granted that we do not tonight forget that distinguished group of men who have been associated with Colonel Goethals; that gallant and devoted soldier, Colonel Gaillard, who gave his very life to see that a great work was done at the Culebra Cut; that man who made so much of this work possible, Surgeon General Gorgas, by knowing how to hold disease off at arm's length while these men were given leave to work; also Colonel Sibert, who built the Gatun Dam and created the Gatun Lake, making it look to the eyes of the uninitiated as if nature had done the work over which he himself presided, and also Colonel Hodges, who made the locks and the machinery by which these great things are administered.

But we are merely tonight acknowledging the presiding character and genius which drew all the elements of this work together, which made it a work done by colaborers, not by rivals; work done as if it were the conception of a single mind; work done in the spirit of service and self-effacement which belongs to a great servant of a great government. There is nothing selfish in the eminence of Colonel Goethals. It is representative of a great government. It is representative of a great government. It is representative of a great government. It is representative of a great spirit.

I am glad that this thing was not done by private enterprise, and that there is no thought of private profit anywhere in it, but that a government put itself at the service of the world and used a great man to do a great thing. That is the ideal of the modern world, that the services to mankind shall be commonly shared.

And so I esteem it a real privilege, acting on behalf of this Society, to present to you, Colonel Goethals, this very beautiful medal. It is made of mere gold, and gold is of no consequence in this connection, sir; but it speaks, in the most precious metal we know, the gratitude and the admiration of the nation.

RESPONSE BY COL. GEORGE W. GOETHALS, U. S. ARMY

Mr. President, it is an easier task to build the Panama Canal than it is for me to find words to express appreciation of the honor conferred upon me by the National Geographic Society and the distinguished manner in which the presentation of the medal has been made. This medal represents the satisfaction of the National Geographic Society at the practical completion of the canal and its approval of the services rendered. Those services are not only individual services. but national services. The French were the pioneers in the undertaking. But for the work that they did on the Isthmus we could not today regard the canal as practically completed. But for the English we probably would not have known the means of eradicating malaria; the death rate would have been great. Among individuals we have national representatives in the Spanish and the English in our laboring force.

The canal has been the work of many, and it has been the pride of the Americans who have visited the canal to find the spirit which animated the forces. Every man was doing the particular part of the work that was necessary to make it a success. No chief of any enterprise ever commanded an army that was so loyal, so faithful, that gave its strength and its blood to the successful completion of its task as the canal forces.

And so in accepting the medal and thanking the National Geographic So-

ciety for it, I accept it and thank them in the name of every member of the canal army.

SECRETARY BRYAN

The Isthmian Canal is an international work. It connects the oceans that wash the shores of every land, and through it will pass the commerce of all the nations. It is fitting, therefore, that we shall have as participants in the program of this evening those who in an eminent way represent the nations which will take conspicuous advantage of the opportunities which this canal will offer, and at our table tonight we have as one of the speakers the representative of one of the great nations of Europe, one of the nations whose growing fleets are known in all the corners of the earth. I have the honor to call upon His Excellency, the Ambassador from Germany, to give his testimony to the greatness of this undertaking and pay his respects to the genius under whose guidance the work has been accomplished.

ADDRESS BY THE GERMAN AMBASSADOR,
AMBASSADOR VON BERNSTORFF

When I received the kind invitation to attend this splendid banquet, I accepted with the greatest pleasure because it afforded me the occasion to renew my friendly relations with Colonel Goethals, the greatest engineer of these days, who has presented to the world an engineering feat which in ancient days would have been called one of the Seven—I do not know how many wonders of the world we have now.

I had also wished to meet the charming wife of Colonel Goethals, with whom I had formerly spent a very pleasant week on the ocean. I was not disappointed in that, as I had the pleasure of sitting next to her at dinner.

In one way, however, I must confess that I was very much disappointed this evening, because I had been told that I was to have a very good time tonight and a night off from speaking. A quarter of an hour ago, however, I was asked to say a few words to you, and I am very glad to have this opportunity to thank you for the splendid hospitality afforded me.

The presiding officer of your Society

told me before that this Society was carrying on an investigation—one of the many investigations of these days—which was to result in finding a way by which people should work only two weeks in the year and live in happiness and plenty all the rest of the time. Now, if your Society manages to achieve this wonderful result I hope it will be applied to the foreign ambassadors to the United States, because that would mean only fourteen speeches a year instead of about one hundred or more.

These diplomats always feel at home in a society of geographers, because we are what I might perhaps call practical geographers. Without knowing where we are going or whence we come, we are sent all over the globe and we regard the whole universe as our home. It is not always so pleasant as it is here, and we are therefore very glad when on this large globe we find such a pleasant and hospitable home as we all find in the United States.

As a German, I would like to remind you of an incident in the life of perhaps the greatest of my compatriots, Goethe, who a hundred years ago, shortly before his death, was sitting among his most intimate friends, and had just received a book written by Alexander von Humboldt, a name which is familiar to geographers all oyer the world. It gave a description of Mexico and the surrounding countries, and after having read this book Goethe said to his friends, "I am a very old man, and I have only one wish: that is that I could live long enough to see the Panama Canal built."

He added that he was sure this canal would be built by the people of the United States, because he saw by the energy and enterprise with which they colonized the whole west of this great country that they would surely not miss the opportunity of building this canal. I wish I could evoke his spirit to be among us today. He might find it a queer coincidence that his name is so much like the name of the great man who built this canal

Before sitting down I wish to thank you once more for your kind hospitality and for the great pleasure you have afforded me tonight.

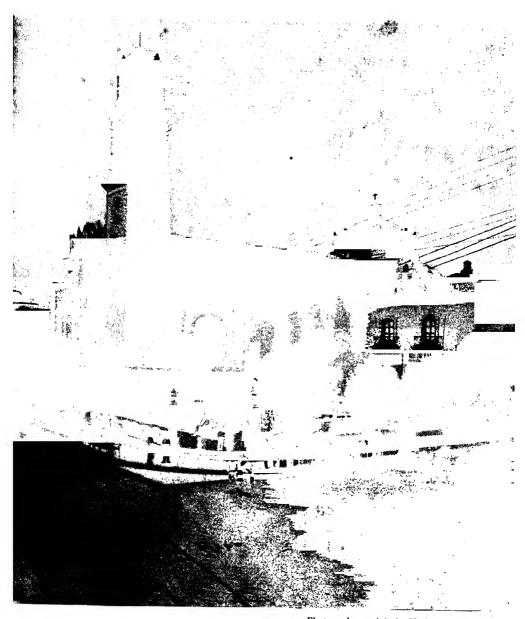


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THE CATHEDRAL—THE GREATEST OF MEXICAN CHURCHES: NORTHWEST FROM THE NATIONAL PALACE ROOF, CITY OF MEXICO

The cathedral of Mexico City is said to be the largest church in the Western World. It stands on the site of the great temple of the Aztecs, where tens of thousands of prisoners were sacrificed to the sun. Its foundations are composed almost entirely of Aztec images. Its inside dimensions are: length, 387 feet; width, 177 feet, and height, 179 feet. It is estimated that it cost some \$2,000,000.

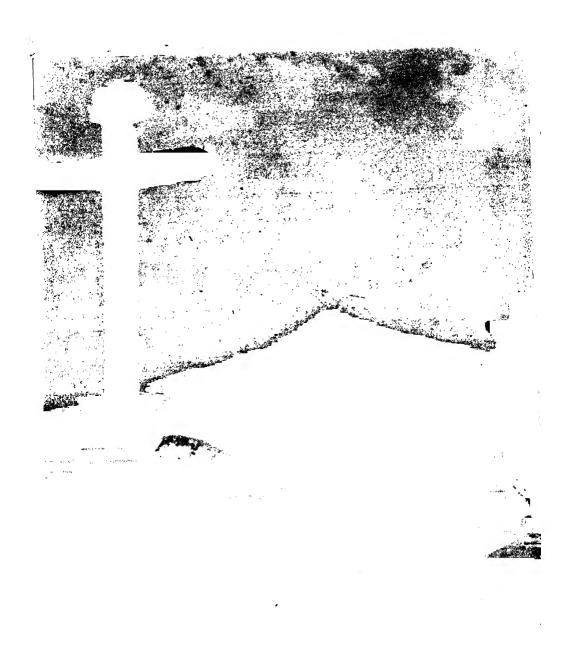


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THE MAGNIFICENT POPOCATEPETL FROM THE LARGEST OF THE ANCIENT AZTEC PYRAMIDS AT CHOLULA, MEXICO

The landscapes on the great Mexican plateau are always filled with interest. A dozen cities surround each of the great Mexican volcanoes, and whether Popo is viewed from Puebla, Mexico City, Amocameca, Cholula, or Cuautla, it is always the same graceful mountain (see also pages 630 and 641).

SECRETARY BRYAN

To build this canal it was not only necessary that some should dream of it, but it was necessary that some one should finance it, and whenever in this country the government needs money it must go to Congress, which controls the nation's We have gone to Congress and Congress has supplied us liberally. All bills have been paid thus far. But it is appropriate that as we are not quite through we should keep on good terms with those who must furnish the balance. And so tonight, with the wisdom that has characterized it in so many ways, the National Geographic Society has taken care to provide that a representative of the House of Representatives should be here to receive your thanks for the money already given and your supplication for that which is needed. I have the honor of introducing to you Congressman Mann, of Illinois.

ADDRESS BY HON, TAMES R. MANN

I can assure the Toastmaster and those who are here that there never has been and that there never will be any difficulty in obtaining all the money that is necessary for the construction and the operation of the Panama Canal, and that is especially true while the Committee on Appropriations is presided over by the genial and handsome gentleman from New York, Mr. Fitzgerald.

I served in the House of Representalives on the committee having jurisdiction in regard to the Isthmian Canal when it was first proposed by Col. William P. Hepburn, of Iowa, the chairman of that committee, that the Isthmian Canal should be constructed not by a private corporation, not by a private enterprise, out should be constructed and owned by the United States itself. We owe a debt of gratitude to him for that proposition, the result of which was the negotiation of a new treaty between the United States and England and the final undertaking of this government by the governnent itself to construct the greatest civil engineering enterprise which the world nas ever known.

The dream of ages was about to come true, the longing of the centuries was to

be realized, the hope of the navigators for those years in the past was soon to become a reality, and the two oceans were to be united. There stood the work in contemplation; it only needed the man. Others retired; others despaired. This man retained his confidence; others quit. He kept his commission; others failed; he succeeded. The man and the work came together when Colonel Goethals was placed in charge of this great undertaking.

No one who has visited the Canal Zone and watched the operations of the force there will be surprised to know that that force idolizes the Chief Engineer. spoke a moment ago of how each man in the work performed his duty with a single eye to true devotion; but you would not know from that that all along the line of the canal, from ocean to ocean, as the Chief Engineer passes by every employee there speaks lovingly, "There goes the old man." And "the old man," as they lovingly call him, tips his hat to every employee, from switchman to his chief lieutenant. He has made them love him; he has made them devoted to the cause. He, with those under him, has made this great undertaking reflect credit upon government, upon national enterprise, upon the American people, upon humanity, upon our own government, because he has succeeded in doing that which no one dared to really hope could be done; that the government in this manner would be able to spend hundreds of millions of dollars in the construction of the great work by direct employment of government officials and employees without serious scandal. It never has been done before on such an enterprise on such a scale, and I hope that our country will recognize that peace may have its victories as well as war.

The heroes of the past have been made in war. Here is a hero whom we ought to put upon a pedestal as an inspiration to our children and those who live now and who come after, that those who do their full duty in time of peace may enjoy the same lofty ideals as those who win in war; and I hope that the title "Colonel" Goethals will soon be gone, and that we will salute him as "General" Goethals.

SECRETARY BRYAN

It might be expected that all Americans sharing in the honor which Colonel Goethals has brought to the nation would be glad to pay tribute to him. It is to be expected that when there is the conjunction, the preparedness and opportunity which constitute success, that we should all rejoice. It is to be expected that we shall all behold with joy and admire the flower that springs from the place where great preparedness and great work meet. But I am glad that on this occasion we can have as a representative of the outside world one whose people began the work which our people completed. This meeting tonight would not be what it ought to be if we did not hear from one of that great nation which first called the world's attention to the fact that it was possible for man to unite these two oceans in perpetual wedlock, and we are fortunate in having as the spokesman of that nation one who can speak so sympathetically to our people, while with such fidelity he represents his own.

The National Geographic Society has asked me to present a certificate of honorary membership to the gentleman whom I am about to call upon. It is presented to him for the double reason that his nation deserves a part in this great undertaking and because of the personal interest that he has always manifested in the work of this Society. Therefore it is my pleasure as it is my honor to present this certificate of membership to His Excellency, J. J. Jusserand, the French Ambassador, and to ask him to represent the nation that gave the initiative to the canal to which we give the completion.

ADDRESS BY THE FRENCH AMBASSADOR, J. J. JUSSERAND

I lack appropriate words to express my gratitude for the signal honor that has just been bestowed on me, especially when I think that it comes from this great National Geographic Society, whose members are as numerous as the sands of the sea—or nearly so, and in which American science is represented by a man like Dr. Graham Bell, the American Army by such an explorer, a pioneer, an early discoverer as General Greely; the American Navy by the man who reached the goal at which so many had aimed and planted the flag of the United States at the North Pole, Admiral Peary.

It is a very great and important thing to hold a record, and on the present occasion, among your honorary members, I certainly hold one—the record of undeservedness. I have no doubt—and in saying so I am acting as a well-wisher of your Society—that I shall hold it long.

I feel in a way guilty in not having better titles, when I think of my youthful preparation and of having been early taught many of the arts useful to explorers: to ride, swim, jump, climb, and even walk. Thus, when small boys, carrying all our luggage on our backs, we did a good deal of exploring in, it is true, not very remote countries; some, however, with whose language we became familiar We were very proud only in after-life. to be able to address at need a priest in Latin and get from him directions as to our way. But I shall blushingly confess, in the presence of my German colleague, that we were once confronted with the terrible fact that, being in a small out-ofthe-way place in his country, none between us four could remember more than half the word railway. Eisen came to the mind of one of us, and nothing fur-We missed our train, and shall never forget that the whole word is Eiscnhahn.

Of real explorations, I have none to my credit. I set foot on four of the five parts of the world, but from the Nile to Seattle, or Petersburg to Panama, I saw nothing but what others had seen. My chief journeys to far-off lands have been through a medium greatly to be commended, and which consists neither in railroad, steamer, horse, nor camel, but in the National Geographic Society's Magazine. Through it you can visit all the world and know the secrets of the most remote places. Happier than Mahomet, who ordered the mountain to come, but it would not, so that he had to go to the mountain, we beckon to lake and peak, ruins, icebergs, cities, and deserts, and behold, here they come in their true shape and colors!

In my undeservedness one thing pleases



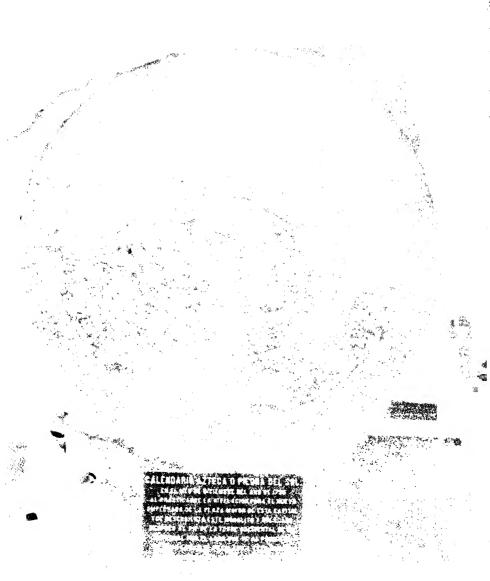


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WONDERFUL WITNESS TO AZTEC ENLIGHTENMENT: CALENDAR STONE DISCOVERED IN 1790 AND NOW IN THE NATIONAL MUSEUM, MEXICO CITY

This stone is of basaltic porphyry, 22 feet in diameter and 3 feet thick, and weighing about 24 tons. It was first found in the subsoil of the present cathedral square of Mexico City about the middle of the seventeenth century, but Archbishop Montusar, fearful that it would influence the Indians to revert to idol worship, caused it to be reburied. The central figure of the carving represents the sun. Within the first ring are the names of the Aztec years; within the second ring the Aztec days of the month. Prescott says that the accuracy with which they adjusted their festivals to the movements of the stars and fixed the length of the tropical year was with a precision unknown to any of the great philosophers of antiquity.

me—that which has made up for my lack of merit—namely, your friendly disposition toward me, and, I feel confident, your consideration for my country. If I have done little, my country has done much. Since our republic has been established a renewal has been apparent of the exploring spirit of the sixteenth and seventeenth centuries.

France has produced new Laudonières, new Cartiers, new La Salles, new Champlains. We have built in Asia and Africa the largest colonial empire France ever possessed, and we have done so more by discovery than by war. The French are "harborous to strangers," said Sir Thomas Overbury. That characteristic has been

a great help.

The first thing we did wherever we got was to build a road, then a school, and in that school we had the natives taught not only, nor even chiefly, our language, but theirs, and even in many places their own theology. Our officers have acted at need, in large numbers, under various skies, as instructors, builders, agriculturists, archeologists, artesian-well drillers, trying not to destroy, but to improve; to which many American travelers have borne a testimony in which we take pride.

The value of the diploma you have bestowed on me is enhanced by the fact that I receive it on an occasion the hero of which is Colonel Goethals. long known him, and I may say that it was, on my side, a case of friendship at first sight. It is difficult to meet him and not understand the cause of that great influence he has over his fellow-men; one feels at once that he cannot ask any one to do anything but what is right, proper, wise. Any man in his senses acts as he is bidden by him. I have seen him, so to say, in action on that great canal along whose banks so many of my compatriots have found their last resting place; where I saw, with some pride, the white line, not so very near the summit, where we stopped in the Culebra, and I raised my hat to some of our dredges and machinery, still at work after so many years and still contributing to the mighty task.

I had the honor of visiting the canal in the President of the Commission's yellow car, familiarly called "Goethals' yellow peril," because people who prow about the tracks must move rapidly when it comes, if they do not want to change from this world to another. In the Zone one single man was all-powerful, and his chief strength did not lie in the regulations which had defined his office, but ir his moral influence and the respect with which he was surrounded.

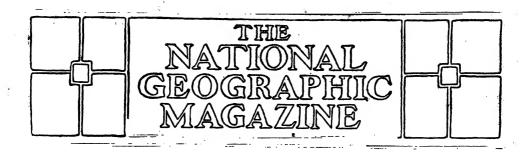
We left the canal not knowing which to admire most, the Babylonic grandeur of the material work then nearing completion or the strength of character in one man's breast, which set in motion and regulated the forces used in the perfecting of the enterprise.

I am thankful to you for having given me this occasion to add to American good wishes and congratulations for the work and for the man, French good wishes and congratulations.

SECRETARY BRYAN

While the program as printed is completed, we are not quite through. No one will be called upon for a speech, although there is one subject that has not yet been presented—the happy coincidence of name and accomplishment. How appropriate that it should have been George Washington Goethals who did this work. Who will say that there is no inspiration in a patriotic name?

But I am not willing that this meeting shall conclude until I have performed a task laid upon me by this Society. We have heard from representatives of our own and other countries, and the President has spoken for all the people of the United States in presenting this medal of honor. I am sure that you desire to express yourselves, each one for himself or herself, and I am sure that you will welcome the opportunity that I am asked to give you. While the name of the man will be inscribed upon all the monuments that are erected at Panama, the name of the wife who has stood by him in his work and shared the dangers and the trials of the task will not be forgotten. As a fitting conclusion of this most appropriate occasion, I ask you to rise and drink to the life, health, and prosperity of Colonel and Mrs. Goethals.



HUNTING WITH THE LENS

By Howard H. CLEAVES

With Photographs by the Author

OT long ago one of our foremost ornithologists surprised me by remarking that, in his opinion, the work of bird protection in this country had been carried to an extreme! He pointed out that every great bird student, to his knowledge, had received his start by collecting eggs and making up study skins, but that the doing of these things lies beyond the reach of the present-day lad by reason of the strictness of the law.

I ventured to suggest that most of the famous ornithologists had made their beginnings before the era of the camera and the inexpensive field-glass, and that through these instruments as mediums the youth of the twentieth century can develop and maintain as deep an interest in bird life as his counterpart of a hundred years ago was led to do as a result of collecting.

As a matter of fact, this is an age of popular interest, and is getting to be one of conservation as well. The scientific specialist will ever be with us, and it will always be possible for him to secure necessary material for his intensive studies; but to open the way for every one in the land to destroy such quantities of wild creatures as might be deemed essential to develop within him the foundation for a scientific career would be a decided mistake. It were better to have fewer scientists and more birds.

Not, after all, that those truly interested in research have made any appreciable inroads on the bird population—although Audubon himself, in telling of his Florida episodes, says: "Each of us, provided with a gun, posted himself behind a bush, and no sooner had the water forced the winged creatures to approach the shore than the work of destruction commenced. When it at length ceased the collected mass of birds of different kinds looked not unlike a small haycock"—but laws which are left loose for a worthy purpose are certain to be taken advantage of by the greedy and unscrupulous.

This account and the accompanying pictures are submitted to the reader with the special purpose of emphasizing the truth of the already oft-repeated contention that it is more glorious and profitable to shoot birds through a lens than through the bore of a gun. The photographs are all of birds to be found in eastern North America, and might have been secured by any person with standard photographic equipment and a fair supply of energy and patience.

DIFFERENT TEMPERAMENT IN DIFFERENT BIRDS

The infinite variety of problems that must be met and overcome in securing photographs of wild birds under natural conditions should appeal to any one who has even a spark of ingenuity. The mode of procedure applied successfully to one subject may fail completely in the case



Photo by Howard H. Cleaves

A "TURTLE CRAWL": RACCOON KEY, BUILLS BAY, S. C.

The female turtle drags herself up the beach above high-water mark after dark and digs a nest, where, according to the age and size of the turtle, from 75 to 200 eggs are deposited at a single laying.

of another. In this event a new course must be devised, and if this fails a third must be resorted to. It keeps one's wits on the move and compels a close study of the habits and idiosyncrasies of the numcrous birds which one meets; and this, after all, is the true end to be gained and desired.

The difference of temperament in different birds and, moreover, in different individuals of the same species can best be illustrated, perhaps, by the following incidents:

The first was furnished by a yellowbilled cuckoo. She had her nest in a dense piece of woodland and placed near the top of a seven-foot bush, beneath a canopy of leaves, which, together with the shade of the forest, produced wretched light conditions for photography.

The time was late afternoon, and before the old bird came back to the nest, with the corpulent caterpillar of a hawk moth for the two young cuckoos, an electrical storm had obscured the sun entirely, and the rumblings of thunder made it apparent that camera, tripod, and all would soon have to be withdrawn or be drenched. But the young cuckoos were so far developed that they would be out of the nest by the following morning; so, if a plate were to be secured of the old bird beside her young, it was plain that it must be exposed within the next five minutes or not at all.

As this crisis was reached there occurred a movement at the far side of the bush and in an instant the old yellow-bill was standing at the edge of the nest, her tail drooping and head turned to one side. The shutter had been set for a time exposure and the thread leading to it was given a cautious pull.

At the opening click the old bird's head turned slightly; but from that moment until the remarkable exposure of 57 seconds (made necessary by the light conditions) was brought to an end by a second snap of the shutter spring, the cuckoo remained like a statue, and the resulting photograph was fairly satisfactory. Such a course could not have been followed with a less passive and apparently stupid bird than the cuckoo.



Photo by Howard H. Cleaves

GATHERING THE EGGS OF THE TURTLE

The turtle usually comes ashore in late May or early June and deposits her eggs in a hole she digs in the sand. She lays an enormous number, ranging from fifty to a thousand, according to her size, scoops back the sand, and returns to the sea, never again bothering about her eggs. If these are undisturbed, they hatch in from six to eight weeks. The baby turtles have to shift for themselves, and as soon as they are hatched they seek the water; but they are not willing to risk themselves in the open sea until they have developed their powers of navigation in some shallow inlet. In gathering the eggs, the exact location is first determined with a stick; then the egger digs through two feet of moist sand to the top layer of eggs. The sand is allowed to cling to the shell until the egg is about to be cooked.

My friend and fellow bird photographer, Mr. Clinton G. Abbott, had an experience with a cedar waxwing which illustrates this point. The nest was located in a shady place, necessitating the taking of time-exposures only. But the bird was nervous and turned her head each time at the click of the shutter, producing only a blur where her head should have been and spoiling plate after plate. The clever photographer overcame the difficulty by hanging an alarm clock beneath his camera. The waxwing

soon became accustomed to the sound of this instrument and a perfect photograph was secured, for when the thread was pulled to make the exposure the "clicks of the shutter intermingled perfectly with the ticks and tocks of the clock."

One soon discovers that there is a vast variation in the dispositions of different individuals of the same species. In working with the fish-hawks on Gardiners Island we found that some returned to their eggs or young almost as soon as one had disappeared within his umbrella



Photos by Howard H Cleaves

There is still much work left for the Audubon societies and the Federal government to do it is supposedly illegal to take the eggs of wild birds in Virginia, and yet each day for a month or two the eggers go off to the nesting islands and rob the nests of the sea-birds at Wreck Island, Va

A TOTAL OF 136 EGGS

The native eggers peddle these turtle eggs in the streets of Charleston and Georgetown (S C) for 12 to 15 cents per dozen. They are considered a great delicacy by the natives, although the author found the flavor and texture to be quite disagreeable

THE "HAUL" FROM THE TURTLE'S NEST (SEE PAGES 2 AND 3)



A PIPING PLOVER AND YOUNG "PERMITTED A SURPRISING DEGREE OF FAMILIARITY": MARTHAS VINLYARD, MASS.

'By simply holding the camera in my hands and standing in the open, without concealment of any kind, I was able to photograph the bird as she approached her nest and brooded her newly hatched young" (see text, page 8)



PIPING PLOVER

Photos by Howard H Cleaves

"Proved herself to be the most devoted shore-bird mother that I had ever met. . . . I put my hat over the nest in the absence of the old plover, and was nearly convulsed by watching the 'circus' when she returned. . . . To hear her offspring and yet not be able to find or see them was quite inexplicable. Round and round the hat she ran, piping away in the meantime and now and again stopping to listen—a peep from a youngster being sufficient to start her off again" (see text, page 10).



A YOUNG GREEN HERON REGAINING HIS BALANCE ON A PERCH

The dark patches at either side of his head are not the eyes but the inside of the mouth illustrating the spring-like character of the lower mandible



Photos by Howard II Cleaves

ONE OF THE "BEACH PATROL": SPOTTED SANDPIPER

A bird easily photographed near home—a common nester in the eastern United States



COMING IN SWIFTLY FOR A STRIKE FROM THE REAR, TALONS LOWERED READY FOR INSTANT ACTION

"It is only necessary, then, to secure a stuffed owl and place it on a perch in some open site in order to 'start something' in the bird world. And by concealing one's self near by in a blind, either of the umbrella variety or of some natural objects, such as corn-stalks, cattails, etc., the onslaught may be witnessed and photographed to advantage" (see text, page 12).



Photos by Howard H. Cleaves

A VICIOUS JAB, DEMONSTRATING THE REACH OF A HAWK'S LEGS Here, as in most of the photos in this series, the owl happens to be in a horizontal position, into which shape he was knocked by the hawk



. Photo by Howard H. Cleaves

THE RED-SHOULDER TEARING AWAY THE SIDE OF THE DECOY

The hawk's wings far forward at the "top" of a stroke and tail spread fike a fan. Several crows show in the distance on the wing (see text, page 13)

blind, while others, under precisely the same conditions, proved to be decidedly skeptical and required an hour or more to become reconciled. And now and then a hawk would be accommodating for a time, but would suddenly, without apparent reason, go off and refuse to return so long as the blind was near.

AMUSING EXPERIMENTS WITH A PIPING-PLOVER

I recall working the better part of an afternoon trying to photograph an old piping-plover at her nest without success; but a couple of years later, on a different portion of the coast, I came upon a breeding piping-plover that went

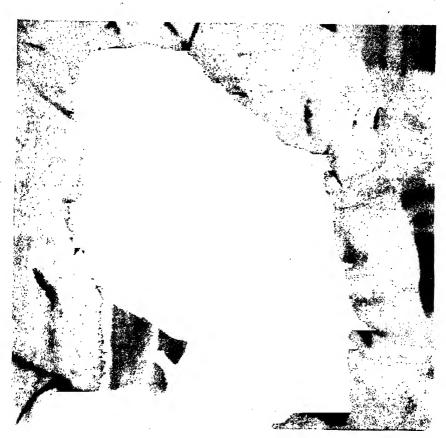
to the other extreme and permitted a surprising degree of familiarity. By simply holding the camera in my hands and standing in the open, without concealment of any kind, I was able to photograph the bird as she approached her nest and brooded her newly hatched young.

Not being content with this, I put my hat over the nest in the absence of the old plover, and was nearly convulsed by watching the "circus" when she returned.

She came unerringly back to the nestsite, which perhaps she recognized by the two familiar tufts of beach grass, one of which stood on either side of the nest; but here between them was a peculiar hillock that had grown up during the



AN ATTACK FROM THE SIDE



Photos by Howard H. Cleaves

THE MOUNTED BARRED OWL AFTER THE FRAY

Showing one eye hanging by shred of cotton, hole over the eye, and large rent in bird's side where excelsior is exposed



Photo by Howard H. Cleaves BELLOWING OVER THE LAKE TO HIS MATE

brief time that she had been away. She came to a dead stop three inches from the brim of the hat and fluffed out her feathers indignantly, at the same time uttering a series of plaintive, piping whistles. This brought forth a muffled response from the young, and instantly the old bird became highly excited.

To hear her offspring and yet not be able to find or see them was quite inexplicable. Round and round the hat she ran, piping away in the meantime and now and again stopping to listen—a peep from a youngster being sufficient to start her off again.

At length the limit of patience seemed to be reached, for instead of circling longer about the obstruction the mother plover headed straight for it, pushing against the upturned brim with her breast and pecking at the material in the crown as if to remove the frightful object. Had there been any purpose in further extending the experiment I should not have had the heart to do it; but there was none, and the hat was removed from the nest

and put in its proper place. The little piper had proved herself to be the most solicitous shore-bird mother that I had ever met.

USING AN OWL FOR BAIT

In seeking to procure bird photographs one should mark carefully the several factors which go to make up the bird's life—his food habits, time and manner of nesting, habitat in winter, and even his roosting place by night, his favorite perch by day (if he has one), and any peculiar whims, likes or dislikes, which happen to characterize his kind. Being possessed of an understanding of these things is identical with having success within one's grasp, if bird photography is the aim.

The simple knowledge, for instance, that hawks, crows, jays, and many other of the land birds are the sworn enemies of the owls is sufficient to put one in a position to conduct a highly entertaining experiment and one which is likely to produce a series of striking photographs. The reason that so many birds display

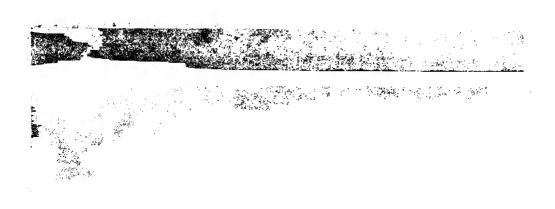


Photo by Howard H. Cleaves

THE "STAMPING GROUND" ON NESTING ISLAND IN LAKE GEORGE

Here the gulls preen, feed their young, play, and sleep; also a trail (open space in bushes) where birds walk to and from the shore of the lake. The grass has been torn up by the roots and trampled under foot to keep the space clear.

this deep antipathy toward owls is probably that the nests of the former are occasionally rifled during the night by the latter, and at times the owl actually captures roosting adult birds, as their feathers found in the owl's nest-cavity or daytime retreat would testify.

It is no wonder, then, whenever an owl is so unfortunate as to be driven into a conspicuous position during the hours of light that some jay or crow or catbird should break loose with a series of terrible curses at the top of his lungs, and thus call together a bevy of irate confederates, who proceed to mob the poor bird of the night.

It is only necessary, then, to secure a stuffed owl and place it on a perch in some open site in order to "start something" in the bird world. And by concealing one's self near by in a blind, either of the umbrella variety or of some natural objects, such as corn-stalks, cat-tails, etc., the onslaught may be witnessed and photographed to advantage. An account

of one or two of the writer's experiences with a mounted owl may be of interest.

I had been rambling through some marshes near the quaint old village of Keyport, New Jersey, and chanced to fall into conversation with an old fisherman who practiced taxidermy as an avocation. It is always well to look over the mounted specimens in possession of these isolated naturalists, for an Eskimo curlew, passenger-pigeon, or some other rarity may be found perched on a bureau, sideboard, or mantelpiece. There was just one bird in the fisherman's collection that interested me, and this was a barred owl which gazed out over the room from his position on top of the grandfather's clock. I wanted that owl. My host protested, saying that the specimen was falling apart, due to age, and asked if I wouldn't care for some other mount. But I insisted that I cared only for the owl, and at last its owner wrapped up the shabby-looking bird and apologetically accepted a dollar for it.



ADMIRING THEIR OWN FEET

Photo by Howard H. Cleav

This was a failing among the black-backs. It was often done after the preening was completed

With new eyes and a change in posture, the owl looked like the real, living thing; indeed, it worked almost too well when put out for the experiment. The dummy was perched prominently on a side hill, and with a companion I crawled beneath a canopy of pine boughs and gave a few scolding crow-calls to bring on the vanguard of the mob.

SAVAGE ATTACKS BY A HAWK

Like magic, fish-crows and common crows appeared on the scene, seeming to come from every point of the compass. They formed themselves into a croaking, cawing, swirling spiral and heaped their wrath upon the immovable barred owl on the side hill below.

Soon a red-shouldered hawk sailed smoothly out from a woodland to investigate the row. On sighting the owl he broke into rapid flight and went screaming at the head of the poor wretch.

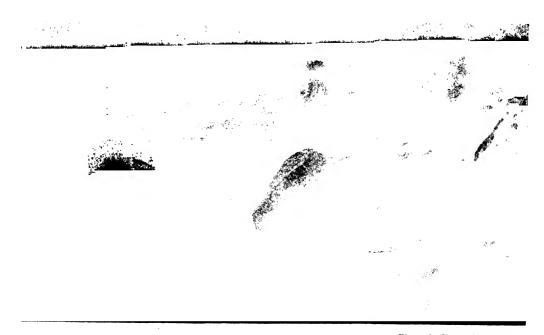
The uproar had reached its height and one photograph had been made when suddenly the hawk left the scene, and the crows, with a few sharp caws, faded into the distance. Looking from the blind, we perceived a bare-headed woman and her son racing toward us through thickets and brambles, and when we stepped forth and the woman came up to where we stood she demanded to know what we were doing to the birds. It was a striking demonstration of the spirit of bird protection, even though our sport had been spoiled for the day.

The next time the owl was put up in a spot more remote from human habitation and with uninterrupted success. A fish-crow was the first to give the alarm, and presently there were fully 75 crows in the air and in trees close by. Care had been taken to put the dummy only a hundred yards from the nest of a redshouldered hawk, and the male bird, who had been noted scouting about the vicinity, was not long in being attracted by the rumpus.

Strangely enough, this very hawk few minutes before had been harassed by the crows, but in the presence of the new enemy the black raiders forgot these former differences; in fact, they were quite willing to resign in favor of the red-



Apparently possessing a fondness for play, the old black-backs now and then pick up a cast feather, a dead fern, or other object and carry it about. Note bird on left. A downy youngster is following at the right (foreground), begging for food.



Photos by Howard H. Cleaves

THE LONG-DELAYED MEAL IS AT LAST SERVED

Half-digested fish, captured in the Bay of Fundy or the ocean, are disgorged before the young gulls on the breeding islands in Lake George, several miles from the coast



THE OLD BIRDS ARE EXCEEDINGLY CLEANLY

They often wash their bills in the margin of the lake after delivering a meal. (Immature gull in foreground enjoying the remnants of a dainty morsel)



Photos by Howard H. Cleaves
PLACK-BACK PREENING RUMP FEATHERS, OR POSSIBLY REACHING FOR OIL SAC

SKIMMER ON HER NEST, RESTING HER BILL ON THE SAND. NOBODY SEEMS TO KNOW WHAT PURPOSE THIS HABIT ANSWERS

Photo by Howard H. Cleaves



Photo by Howard H. Cleaves

KILLDEER: THE SPOT SELECTED FOR THE NEST WAS IN THE CENTER OF A POTATO FIELD

The photographer may be dimly seen under the tree in the background, where he was pulling the thread

shoulder and remained perched about on dead trees, looking on at the assault.

The whole thing was strikingly like an arena battle, with the crows cawing and croaking approval and encouragement from their points of vantage while the furious and screaming red-shoulder dashed in at the non-resisting owl in the pit below. First the dummy got a whack on the back of the head and then in the face, and at each blow the air was full of feathers (see pages 8 and 9).

The hawk selected two perches—one

to the east and the other to the west of the owl—and back and forth between these he flew, striking viciously at the enemy each time as he passed, occasionally wheeling and delivering a double-barreled blow before going on to his lookout. The owl was now knocked into an almost horizontal position by a strike from the rear, and now bent into a normal, upright attitude by an attack from the front; and there he would sit, solemn and erect, ready for the next rush.

Whenever the hawk lagged the least



Photo by Howard H Cleaves

A "SEA-SWALLOW," OR COMMON TERN, MAKING A QUICK TURN: MUSKEGET ISLE,
MASS

bit in his attack he was instantly spurred on by a hooting which to him apparently seemed to come from the owl, but which really came from within the umbrella blind near at hand.

During the siege, which lasted for many minutes, eight photographs were secured and the dummy was the recipient of 19 head and body blows.

The poor owl was a sight when taken from the perch and cannot even be repaired for future use. Great tufts of excelsior protrude from his back and sides, one eye hangs an inch out of its socket by a mere shred of cotton, and the back of his head is entirely torn away, exposing wire framework and areas of stuffing But he has furnished more than a dollar's worth of fun (see page 9)!

AN ARTIFICIAL GOLDFISH USED FOR BAIT

Perhaps the most carefully thought-out and "highly organized" bird photographic experiment on record (according to the assurances of friends) is that which the writer brought to a successful conclusion near his home on Staten Island, New York, on the 12th of April of the present year, when a fish-hawk, or osprey, was induced to plunge for an artificial goldfish. The details are presented herewith to the readers of the NATIONAL GIOGRAPHIC MAGAZINE.

First of all it might be well to have an understanding of the movements and feeding habits of the osprey, for these have a direct bearing on the case. This large hawk, having a wing-spread of about 5½ feet and being one of the commonest birds of prey in the coastal region, spends the winter in Florida, on the Gulf coast and southward, working up the Atlantic seaboard at the approach of open weather and reaching the vicinity of New York about the last week in March or the first week in April—very shortly after the ice has left our ponds, lakes, and rivers.

At this time the menhaden, or "moss bunker," the chief food of the fish-hawk and a fish which is familiar to all who have lived or visited near the ocean, has not yet migrated up the coast, and flounders and other salt-water fishes are not yet



BLACK DUCK, OR DUSKY DUCK, IN BREEDING GROUNDS, MARTHAS VINEYARD, MASS.

An anxious mother circling about us as we held her young



THE SAME "NIGGER" DUCK PRETENDING TO BE TERRIBLY WOUNDED We were holding her young and whistling in imitation of their cry

Photos by Howard H. Cleaves

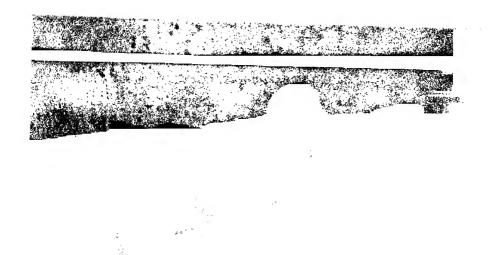


LAUGHING GULL ALIGHTING ON MARSH NEST: COBBS ISLAND, VA.



Photos by Howard H. Cleaves

LAUGHING GULL WHEELING: COBBS ISLAND, VA.



HAVE YOU HEARD OF THE BANDING OR RINGING OF WILD BIRDS?

This now wide movement is throwing light on the problems of migration, and especially on the movements of individual wild birds. (The author banding young black-backed gulls at Lake George, Nova Scotia. Note the camera and binoculars.)



Photos by Howard H. Cleaves

THE BABY ROYAL TERN WITH RING ADJUSTED: WESSEL REEF, S. C. "Notify Am. Museum, N. Y.," is inscribed on each band, and there is also a serial number



SHOWING A BAND IN POSITION ON THE FOOT OF A AOUNG BI ACK-BACKED GULL

一 日日

AN IRATE YOUNG LOUISIANA HERON JUST BANDED The author and his companion (Caspar Chisolm, of Charleston) ringed 80 herons of tive species in a South Carolina rookery in 1913



NEWLY HATCHED YOUNG OF COMMON TERN, OR SEA-SWALLOW: GARDINERS ISLAND, N. Y.



Photos by Howard H. Cleaves
A SCENE IN THE HOME LIFE OF THE COMMON TERN, OR SEA-SWALLOW: FEEDING
YOUNG WITH A SAND EEL, MUSKEGET, MASS.



A SEA-SWALLOW; "WATCHING THEM SETTLE ON THEIR NESTS AS LIGHTLY AS GIANT SNOWFLAKES"

"There is something overpowering and enthralling about standing beneath screaming, gyrating myriads of sea-swallows"

Sec. Sec.

wholly available. The invariable result is that the hawks, for at least three weeks after their arrival from the South, hunt almost exclusively in fresh water — chiefly ponds, where golden carp, German carp, and perch are taken. The first named of these three is most often secured, probably because of his orange - yellow color, which renders him more conspicuous in the muddy waters after the spring freshets.

The fish-hawk's manner of securing his prey is highly spectacular. If hunting over a pond he drifts along the lee shore a hundred feet or so above the surface of the water, facing into the wind and keeping his eyes fixed on the pond below. When a fish is sighted, the bird checks himself directly above the quarry on wings that beat horizontally, and should the prospects be good-if the fish is of proper size and at a suitable distance from the surface of the water-down goes the bird at reckless speed, with wings folded and talons wide open. There is a great splash as the hawk strikes the water and seizes the fish by the back.

Year after year I longed to get an osprey at his fishing game on a photographic plate; but who could tell where a hawk might plunge, and how could one be close enough with a camera to catch the bird at it? The matter was given much thought. It was at first planned to capture live goldfish and tether them out as bait, but the probable difficulty of securing them when wanted and of making them "stay put" was too great.

So I went to my friend, Dwight Franklin, expert modeler in the American Museum of Natural History, and induced him to make for me an artificial goldfish, to measure 10 or 12 inches in length. This

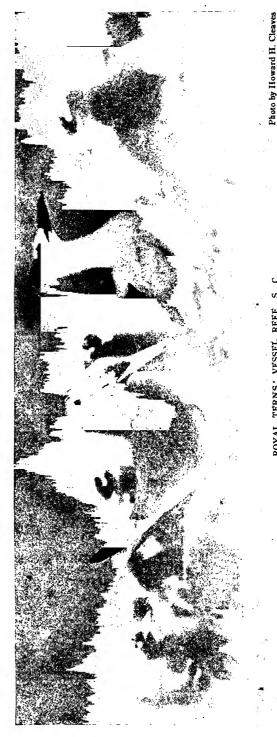
decoy was carved of wood, equipped with glass eyes and celluloid fins, and was given a coat of yellow paint above and silver beneath. When anchored six inches below the surface of the water a short distance offshore, the keenest-eyed fishhawk could hardly avoid being misled.

The day chosen for the trial was fortunately a bright one, making possible exposures of exceeding rapidity. The wind was in the southwest, so the west or leeward shore of the pond was selected and the umbrella blind put up at the wa-With the aid of ter's edge. boots, my companion and helper was able to place the decoy 10 feet offshore, a distance which for several reasons was deemed suitable. The fish was held below the surface by an 18 - ounce rock (the decoy weighing nine), which was tied by a thread to a couple of screws in the belly of the fish.

Another thread was attached to a peg in the snout and run to the inside of the blind, the object being to lend a lifelike appearance to the dummy by pulling the thread and moving the fish about at its moorings when the hawk arrived overhead.

All was now in perfect readiness except that not a hawk was anywhere to be seen! We deemed it best, however, to do our waiting out of sight, and accordingly I entered my blind and my companion hid himself away in an old pig-pen a short way up the shore. Inasmuch as a wider view could be had through a crack in the wall of the pig's shelter than from the peep-hole in the blind, my accomplice agreed to give a signal the moment a hawk was sighted in the distance.

For nearly an hour things were dull—the passing of a kingfisher, with his loud, sput-



sea birds carry on their incubating and brooding activities baby district of New the foreground Crowded as closely together as humans in the tenement

- Photo by Howard H. Cleaves

THE EXCITEMENT OF TOUCHING THE ECCENTRIC WOODCOCK ON THE BACK (SEE PAGE 29)

tering call, the cheery tune of a songsparrow close by, and the sparkle of the sun on the ruffled surface of the pond being the only things to hold our interest.

THE OSPREY APPEARS

Presently there came a low whistle from the pig-pen, and putting my eye to the observation window I could see a hawk sailing toward the pond from the direction of the Atlantic highlands. Soon he was searching the western border of the pond to the south, all the time working in our direction, arriving almost over-

head in a very few minutes. Now was the time to act! The thread leading to the fish's snout was given two or three pulls and the camera pushed into place.

But even before I could get my hand to the shutter release there appeared a shadow over the water, and then there was a splash. The hawk was grappling with the decoy and in a few seconds had raised fish and anchor above the water and was making off with them. I feared for my precious decoy, but at that moment the hawk's talons slipped and his burden (equaling half his own weight)

dropped back into the pond (see illustration).

The osprey, however, was not to be deprived of his breakfast so easily; he was hungry and had met with but poor luck in fishing activities the whole morning. So, instead of going away, he simply circled out over the pond and came up wind looking for the fish again; and the fish, quite unlike any that the hawk had ever met, was there awaiting him.

Seven times the osprey fastened his mighty talons onto the back of the stubborn victim, and toward the last became so exhausted that he lay on the surface of the water for a time with wings outspread, while his claws remained closed on the fish below. The hawk's final act was to drag the fish into shallow water near the shore and stand beside it while he leaned over from time to time and tried to bite into the head of the dummy as it floated on its side.

How long he would have remained standing there cannot be known, for he was frightened away by the noise of the focal-plane shutter in the blind, eight feet away. The bird had not noticed this sound when the previous exposures were made, for he himself had caused so much commotion thrashing about in the water that all minor noises were quite lost.

Although experiences such as the one

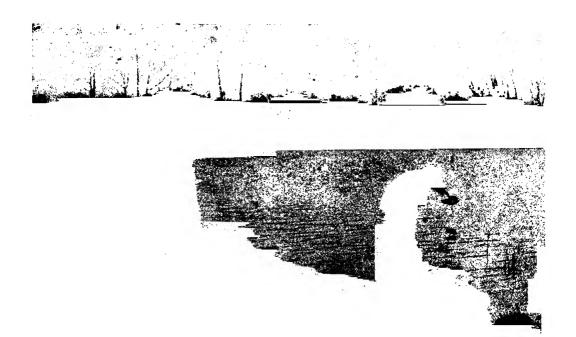
just described are unusual and not often enjoyed, even by those who follow the birds closely, yet there are many out-ofthe-ordinary experiments which one may devise; but, on the other hand, much lasting joy is to be derived from doing and seeing just the "ordinary" things.

THE KILDEER

Who, for example, can recall with anything but pleasure the thrill of finding his first woodcock's nest and the excitement of touching the eccentric bird on the back before she would leave her eggs? And the killdeer! How lasting an impression these vociferous and highly patterned plovers make on a person's mind!

Several years ago a pair decided to stop and nest in a cultivated field near the pasture pond, and it was the best possible fun to watch and photograph them. The spot selected for the nest was in the center of a potato field, and it seemed certain that the eggs would be destroyed when the plants were next cultivated (see page 17).

And yet, were I to disclose the whereabouts of the nest, how could I be sure that human hands would not prove as destructive as horses' feet. The head gardener of the estates where the kill-deers lived was a diminutive, tanned individual—a man accustomed to being



Photos by Howard H. Cleave.

SCENE OF THE OSPREY EXPERIMENT

Umbrella blind on shore and Leland Wincapaw, the author's companion, re-anchoring the decoy after it had been dragged ashore by the hawk

much in the open, and who ought, therefore, to be familiar with birds; but whether he was keen on their protection or not, who could tell?

I approached him, however; told him of the nest and pointed it out to him. He had never seen anything like it and was much impressed. Would he cultivate around it? Indeed, yes; in fact, the whole row of potatoes where the nest was located should not be touched till the young plovers were safely gone; and, to make certain that the site could be easily told, a couple of large stones were placed a few feet at either side of the nest.

It was delightful to discover this spirit hidden away beneath the bronzed exterior of the old gardener. He talked of the birds of his native lakes in Switzerland and remarked how the killdeers reminded him of a bird he had seen at home. And each year since our first meeting the gardener has greeted me warmly and told me how long the "ringlets" had been back, for the killdeers have come each spring to the big gardens and reared their four young under the pro-

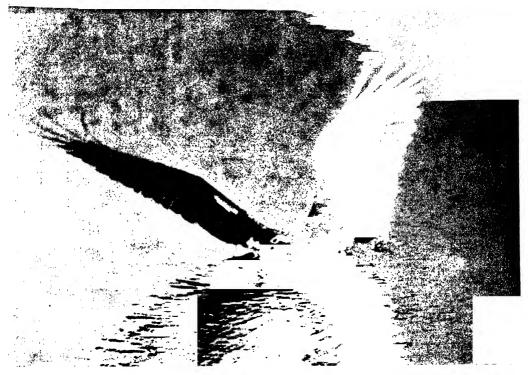
tecting care of the little tanned man and his helpers.

SHOOTING WITH THE LENS

One of the great beauties of bird study and photography is that the subjects are without limit. Should one exhaust the possibilities near home (which is well nigh impossible) or desire to expand his circle of feathered acquaintances, there are always awaiting him the wonderful colonies both inland and on the coast. Or if one is not set on having the spectacular, he may go to the north woods, where the brilliant and shy warblers and other birds of passage make their homes.

But at some time, be it soon or late, one is almost dead certain to come under the spell of the sea-bird. There is something overpowering and enthralling about standing beneath screaming, gyrating myriads of sea-swallows and watching them settle on their nests as lightly as giant snowflakes. And then there are the gulls, petrels, guillemots, puffins, etc., of the islands along the north Atlantic coast, while on the sun-baked dunes and





Photos by Howard H. Cleaves

THE FISH WING-STROKE, AFTER THE HAWK'S TALONS BECAME FASTENED TO THE BACK OF THE DECOY AND THE BIRD WAS STRUGGLING TO RISE WITH HIS BURDEN

marshes of the southern seaboard are the herons, skimmers, oyster-catchers, the giant royal terns, and countless othersall possessing their individualities and making their separate impressions.

A person should not content himself with being told about these bird cities. They are as marvelous in their way as the wonders of the Yellowstone region, and many of them are under the protection and care of the Federal government as are the animals of the National Park. These birds are, therefore, recognized as a part of the nation's resources, and are available for inspection to any well-intentioned citizen on application. There are at this moment 64 of these wildlife reservations throughout the United States and possessions.

SIXTY-FOUR BIRD RESERVATIONS IN THE UNITED STATES AND TERRITORIES

The names and locations of the bird reservations are as follows:

- 1. Pelican Island, Fla.
- 2. Breton Island, La. 3. Stump Lake, N. Dak.
- 4. Huron Islands, Mich.
- 5. Siskiwit Islands, Mich. 6. Passage Key, Fla. 7. Indian Key, Fla.

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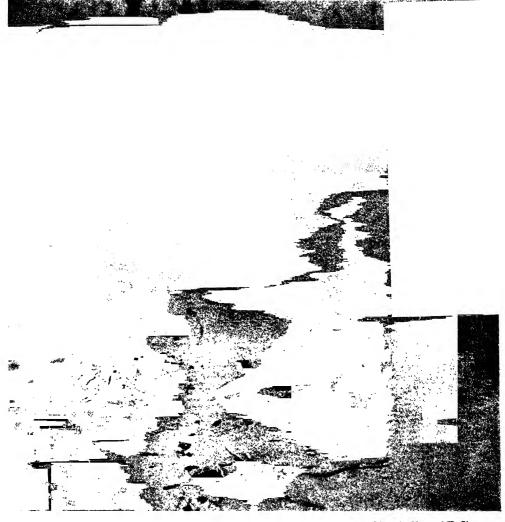


Photo by Howard H. Cleaves

"How long he would have remained standing there cannot be known, for he was fright ened away by the noise of the focal-plane shutter in the blind, eight feet away. The bird had not noticed this sound when the previous exposures were made, for he himself had caused so much commotion thrashing about in the water that all minor noises were quite lost" (see text, page 29).

- 8. Tern Islands, La.
 9. Shell Keys, La.
 10. Three Arch Rocks, Ore.
- 10. Three Arch Rocks, Ore.
 11. Flattery Rocks, Wash.
 12. Quillayute Needles, Wash.
 13. Copalis Rock, Wash.
 14. East Timbalier, La.
 15. Mosquito Inlet, Fla.
 16. Tortugas Keys, Fla.
 17. Key West, Fla.
 18. Klamath Lake, Ore.

- 19. Lake Malheur, Ore. 20. Chase Lake, N. Dak. 21. Pine Island, Fla.
- 22. Palma Sola, Fla. 23. Matlacha Pass, Fla.

- 24. Island Bay, Fla. 25. Loch-Katrine, Wyo. 26. Hawaiian Islands, Hawaii

- 27. Salt River, Ariz. 28. East Park, Cal. 29. Deer Flat, Idaho



Photo by Howard H. Cleaves

SHOWING THE GOLDFISH WITH "FULL RIG" OF FINS BEFORE BEING ANCHORED OUT FOR THE EXPERIMENT

- 30. Willow Creek, Mont.
- 31. Carlsbad, N. Mex.
- 32. Rio Grande, N. Mex.
- 33. Cold Springs, Ore. 34. Belle Fourche, S. Dak.
- 35. Strawberry Valley, Utah. 36. Keechelus, Wash.

- 37. Kachess, Wash. 38. Clealum, Wash. 39. Bumping Lake, Wash.
- 40. Conconully, Wash.
 41. Pathfinder, Wyo.
 42. Shoshone, Wyo.
 43. Minidoka, Idaho.

- 44. Bering Sea, Alaska.
- 45. Tuxedni, Alaska.
- 46. St. Lazaria, Alaska.
- Yukon Delta, Alaska.
- 48. Culebra, P. R.
- 49. Farallon, Cal.
- 50. Pribilof, Alaska.*
 51. Bogoslof, Alaska.
- 52. Clear Lake, Cal.
- 53. Forester Island, Alaska.
- 54. Hazy Islands, Alaska.
- 55. Niobrara, Nebr.
- 56. Green Bay, Wis. 57. Chamisso Island, Alaska.
- 58. Pishkun, Montana.
- *Transferred to Bureau of Fisheries by act of April 21, 1910.

- 59. Desecheo Island, P. R. 60. Gravel Island, Wis. (Lake Michigan).
- 61. Aleutian Islands, Alaska.
- 62. Walker Lake, Ark.
- 63. Petit Bois Island, Ala.
- 64. Anaho Island, Nev.

What could constitute a more ideal vacation trip than packing off in May or June, the height of the birds' breeding period, and traversing a portion of the coast with a view to stopping here and there at the most populous and fascinating bird rookeries? If the writer were to be stricken in the next 24 hours with some malady which would confine him to his bed for the balance of his days, the most highly cherished memories that could come to him would be of his experiences in the big bird colonies of the Atlantic coast. Most of these spots are islands, for there are few enemies on these places such as the land birds have to contend with, and an abundant and constant food supply is always at hand in the ocean near by.

From personal, first-hand experience

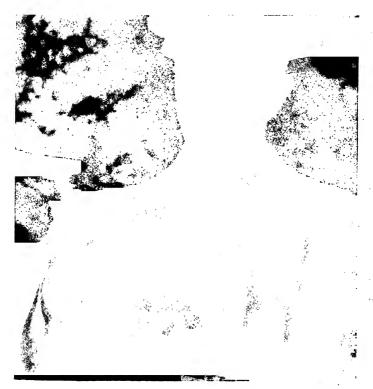


Photo by Howard H. Cleaves

THE DECOY GOLDFISH AFTER THE EXPERIMENT

Showing how fins were all torn away by hawk's talons, and scratches and scars on the back of the fish. The anchor stone, thread, and nose-string are also to be seen

the writer can recommend the following specific localities and general regions:

Scal Island, Nova Scotia, for the herring gull, black guillemot, Leach's petrel, eider duck, Bicknell's thrush, blackpoll warbler, and yellow-billed flycatcher.

Lake George, Nova Scotia, for the great black-backed or minister gull.

Muskeget Isle and Martha's Vineyard, Massachusetts, for the Wilson's or common tern, least tern, piping-plover, black duck, and laughing gull.

Gardiner's Island, New York, for the fish-hawk, black-crowned night heron, common and roseate terns, piping-plover, short-eared owl, parula warbler, and Bartramian sandpiper.

Cobbs, Wreck, and Little Isaacs islands, Cape Charles, Virginia, for the black skimmer, or flood gull, laughing gull, clapper rail, and common tern.

And the coast of South Carolina for a

distance of 60 or 70 miles north of Charleston for the willet, Wilson's plover, oyster-catcher, royal tern, least tern, snowy and American egrets, Louisiana, little blue, black-crowned night, and little green herons, brown pelican, black skimmer, anhinga, or snakebird, etc., and many, many land birds, including the incomparable painted bunting.

To even begin going into a detailed description of the home life of one of these wonderful creatures would require more space than could be allowed in a general magazine article. The writer can therefore but urge the reader to spurn the summer hotel, with its pomp and artificiality, charter for himself a modest sloop or power-boat, and make his way through lagoons and tide-rips to these isolated islands, and follow the picturesque channels of the salt marsh in quest of the bird-inhabited bars and reefs.

YOUNG JAPAN

By ELIZA R. SCIDMORE

THE children of the streets and the children who play in the homes and gardens of the rich are equally the joy of the Empire, the delight of the stranger in Japan, and the distraction of the amateur photographer. All of them seem happy save the unhappy mites doomed to ugly, clumsy European dresses and shoes and hats by their over-ambitious parents. In their own dresses of rainbow crape or blue cotton, they are the drollest, quaintest little images of their grandfathers, and the funny little caps and bibs of the babies make them strange travesties of solemn temple images.

Five hundred thousand little Japanese arrive each year, according to the census records, and all these small additions to the populace for 10 years back seem always to be on view in the streets.

Despite the fable that Japanese babies never cry, they often do lift their voices in pain or wrath; but they seem to have less cause for crying than the babies of the Western World, where so much theorizing has been done about them and great conventions of mothers discuss their needs. Babies are petted and played with here almost more than with us, and no learned young mothers ever lay their babies away in dark rooms alone to sleep.

The little one of the people is never left behind when the mother or the family go abroad. It sleeps and wakes as it rides around on mother's or elder sister's warm back; or, in colder weather, enfolded in the one great matted coat that converts the bearer into an astonishing humpback. It goes to the markets, the shops, and the temples, and holds its place securely while the mother draws water, sweeps, or washes, and then participates in games of marbles or hop scotch and turns pin-wheels and somersaults with elder brother.

The boy or girl big enough to carry a baby on its back usually has one bound there. Several millions of the abundant population are to be classed as the "twostoried," and yet the streets seem crowded with children. Sometimes the fat, loblolly baby seems too nearly the same size as the small brother or sister carrying it, and once I saw a man, trying to comfort one of these weeping little mothers, mount the two on his back, and the threestory group walked away on two feet.

Schools begin early in the morning in Japan, as in Switzerland, and as schoolhouses are well-windowed, draughty and costly to heat, children have their longest vacations in midwinter. In every city one is struck by the numbers of boys in military caps and girls in red hakamas (divided skirts, a school uniform) trudging the streets in the early morning and afternoon, and it impresses one as evidence of great thirst for knowledge or the thorough administration of the law for compulsory education. At recess time one easily finds the school playground by the shouts of the square acre of frolicking children, and from the streets and country roads one sees lines of children doing drills or calisthenics.

In the kindergartens boys and girls drill and play much alike, but after that diverting period the small boy blooms into knickerbockers and a peaked cap, and carries his books in a knapsack on his back. Gymnastic drills become military drills, and at the higher middle school, which is preparatory to the university, the boys get training in jiu-jutsu and in fencing with bamboo swords.

In some schools—notably the Peeress School and others in Tokyo—the girls are also taught the *naganata*, or fencing with bamboo spears; and they, too, can march and perform evolutions like little soldiers, and render first-aid services according to Red Cross rules.

As a people, the Japanese are great walkers, and their sensible foot-gear contributes to the enjoyment of such exercise. Flatfoot, the great and universal American disease, is unknown in Japan, and army surgeons laugh when asked for their records of fallen arches. As their ancestors walked in the train of the daimios up to Yeddo and back again every

year, or made pilgrimage to far temples or famous landscapes, little Japan trudges sturdily about the environs of his city in military formation, or makes railway and walking trips farther afield every Satur-

day in spring and autumn.

One hears the chirp of their voices or some chanted poem as they march through the streets, even before daylight, on these red-letter days. This year all central Japan made pilgrimage to Momoyama, to the tomb of the Meiji Superior, and every day in the week an average of 30,000 school children came by train and joined the decorous crowds that filled the roadways from side to side as they walked up through the bamboo forest to the great, green grave mound on the summit of the hill. On many days 150,000 people visited Momoyama, but the spirit of reverence was so great that there was no noise, no frolicking and shouting, or running at play of all these youngsters.

Most touching of all demonstrations of affection made by his people while the Meiji Emperor lay dying was that presence of legions of school children, who, singly or in groups, bowed low toward the palace walls or prostrated themselves on the gravel to pray that the august life

might be spared.

Wherever the great Emperor had traveled in the land, the school children were always lined up at railway stations to do him honor. The Spartan training and the iron etiquette of Japanese children enable them to stand like statues—or soldiers—in storm or rain, a summer shower affecting these people in their humid climate no more than it does the birds.

Once the Meiji Emperor saw ranks of children standing in the open in swirling snow, and court and local officials never forgot his wrath. "Let this never happen to my children again," said the compassionate ruler; hence every school boy and girl who goes on such errand now, and all who went to Momoyama, had an umbrella strapped to the back with the lunch basket.

While Japanese children may be martinets in good manners when parents and teachers are around, they have as much fun as any other children by themselves. The impishness of street children is even gentle compared to our street arabs, but

baseball and football may teach new standards even to the highest classes. They have their games of tag and follow-my-leader, of blindman's buff, games of cards and checkers, hide and seek, and many mystic rhymes for "counting out." In their indoor games a common forfeit is a dab on the face with the ink brush, and a company of noble youngsters are as 'so many minstrels or coal heavers when they have played long at "twenty-questions" and its kind.

In winter they build snow men as they build sand forts on the seashore, and at the regular spring and fall house-cleaning they wreak their will with the white paper of the *shojis*, or sliding screens, that wall a room from the outer veranda of the house. They love to tear and daub and prod the papers they at all other times treat so respectfully. There are street jugglers and acrobats, dancers and singers, that would set our small folk wild were they called in to help enliven a children's party—little gnomes who dance in masks as tall as themselves, old men with india-rubber faces, who twist mouths and noses and make faces that small boys

only too rapturously copy.

Little Japan drinks tea with as much gusto and as naturally as his elders, and the smallest children manage their chopsticks with a deftness that amazes the blundering stranger, who can make no headway with the magic wands. Children learn to use the chop-sticks and acquire their table manners more easily than western children learn the complicated drill with knife and fork and spoon. The implements are simpler and lighter, and all Japanese food is more completely prepared before being sent to the table. All bones and waste are eliminated in the kitchen, and meat and such solid materials are cut into manageable shreds and morsels before cooking.

Young girls have a rigorous training in household arts and such accomplishments as flower arrangement, ceremonial teamaking, the construction of miniature landscapes in shallow trays or boxes, and playing the koto and the foreign piano. Yet it was the mistress of the most important girls' school who put all the foreign pianos out and dismissed the teacher

the sake of peace and harmony in the school."

Three years of training and practice are not enough to perfect the ordinary pupil in that exquisitely elaborate and refined Japanese art of flower arrangement, where flowers spring, with their leaves and stems, from vases or basins of shallow water as they grow naturally, but Nature perfected and idealized according to codes of rules made by teachers of such esthetic arts for the past eight and ten centuries.

Also the gardens, in which these girls gather for decorous play and games of poetry, are as carefully arranged idealizations of natural scenery, and the soft colors of their crape and silk kimonos accord perfectly with the unvarying garden symphony of gray rocks and evergreen foliage. A soft, grass sandal, especially made for garden wear, protects the precious garden stones and the deeppile mats of fine, soft grass.

The indoor ceremonies of receiving, entertaining, and speeding a guest are matters of careful training, for nothing in Japanese life lacks its conventional rules, its elaborate etiquette. The graceful dress of Japanese women, its sober tones and long lines, is suited to the dainty house interiors, with their fine, satiny straw mats and luxurious crape cushions. The craze for European dress for women, following upon its adoption as the dress of court ceremony 25 years ago, fortunately died out in due time; so

that, except at the palace and on most ceremonial occasions where foreigners take part, Japanese women of highest rank wear their own becoming clothes—a rebuke in its unchanging lines and quiet colors to the insane vagaries of the West.

Each season has its appropriate material and colors. Each year the fashions change in ways the purblind foreigner does not see. Each year the theme of the Emperor's New Year poem gives suggestion to designers and dyers, and in this way these varying patterns of sashes and neck folds date them precisely to the initiated.

Great patterns and gay colors are for children and babies, and from the beginning of time the Japanese woman has folded her robe over to the right that she might hold the edge in place when she bent in a deep bow.

Only in death is the kimono folded to the left, so that there is always laughter when the self-complacent foreigner has her portrait taken or goes to a fancydress ball, or a theater manager clothes a whole company in kimonos folded according to the etiquette of corpses. Nothing else in the world is so funny—not the most luckless attempt of the Japanese woman to wear foreign dress—as the failures and burlesque the foreign woman achieves when she essays Japanese dress. The East has its revenge tenfold at those seasons, and photographers' rooms in Japanese cities are chambers of such horrors.

EXPLORERS OF A NEW KIND

Successful Introduction of Beetles and Parasites to Check Ravages of the Gipsy-moth and Brown-tail Moth

By L. O. HOWARD

CHIEF OF THE BUREAU OF ENTOMOLOGY, U. S. DEPARTMENT OF AGRICULTURE

HE story of the gipsy-moth and that of the brown-tail moth are two of those geographic happenings unconsidered in the old geography, but important in the geography of today. They are not normal inhabitants of the

United States, but are assisted immigrants. The gipsy-moth (see page 50) was brought to this country by a French professor of astronomy in a New England university in the course of some experimental work which he was doing.

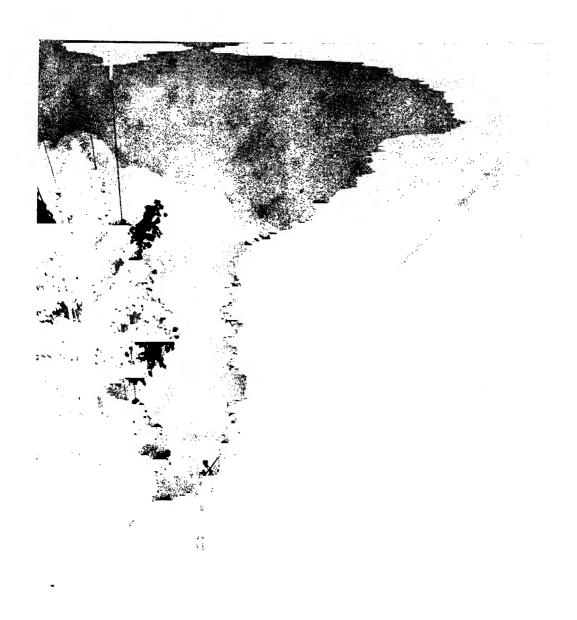


Photo from U. S. Department of Agriculture
SPRAYING WITH A SOLUTION OF ARSENATE OF LEAD TO KILL GIPSY-MOTH CATERPILLARS NEAR BOSTON

Photo from U. S. Department of Agriculture BROWN-TAIL, MOTHS ON A TREE

That sort of importation of insect pests is fortunately rare, and this is almost the only case of the kind on record.

The brown-tail moth (see page 52), on the contrary, came to America in the normal course of commerce. Its winter nests were brought here attached to some rose-bushes which were imported by a Massachusetts florist from Holland, and, unrecognized, the caterpillars issued the following spring and the species soon became established in America.

The gipsy-moth was brought over in 1868 and remained unrecognized until 1889. The brown-tail was brought here in 1891 and was first recognized in 1894.

From 1892 until 1900, both species being confined to the extreme eastern portion of the State of Massachusetts, a fight for extermination was waged against them by the authorities of that State. Unfortunately, certain influences at work caused the stopping of the appropriations in 1900, and from that time until 1905 both insects spread uninterruptedly save for private work on the part of individual property-holders. In 1905 Massachusetts began again to appropriate large sums for the purpose of trying once more to exterminate the pests, and later. as the spread continued, New Hampshire, Maine, Rhode Island, Connecticut began to spend money in the same direction. Then the United States government stepped in, and in an effort not to exterminate the insects, but to prevent their further spread over the face of the country, large sums have been spent annually in the attempt at least to restrict them.

IMPORTING MOTH PARASITES

In 1905 was begun for the first time the attempt to import from Europe and from Japan the parasites and other natural insect enemies of the gipsy-moth, and in the course of this attempt extensive travels have been made by agents of the Department of Agriculture, the services of foreign naturalists have been called in, and enormous numbers of parasites have been brought from all over central and southern Europe and from Japan and have been colonized in the infested region.

The introduction of the pests and their spread furnishes the first geographic feature. The search for their parasites the second, and the third has been the quarantine by the newly constituted Federal Horticultural Board of the United States



THE YOUNG CATERPILLARS ARE CARRIED BY THE WIND SIX MILES OR MORE

The screen shown in this picture is covered with tanglefoot to catch caterpillars in the air. As the young caterpillar of the gipsy-moth hatches from the egg, it spins down on warm days suspended by a silken thread, is caught up by the wind and carried sometimes for miles before it succeeds in attaching itself to a tree or shrub. Large-scale experiments in the last two or three years, conducted by erecting enormous wire screens at various distances to the windward from infested woods, the screens being coated with a sticky substance, have shown that many young caterpillars are carried in this way to a distance of six miles or more.



Photos from U. S. Department of Agriculture

SAWED LUMBER, BEARING EGG-MASSES OF THE GIPSY-MOTH, SERVES AS AN EASY MEANS FOR THE SPREAD OF THE MOTHS

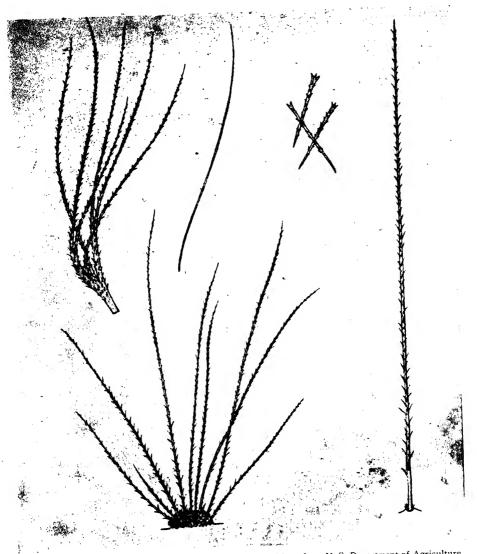


Photo from U. S. Department of Agriculture

THE GREATLY ENLARGED BARBED HAIRS OF A BROWN-TAIL MOTH CATERPILLAR,

WHICH CAUSE THE BROWN-TAIL RASH (SEE TEXT, PAGE 48)

of the infested areas in New England from the rest of the United States, and all of Europe and Japan from the United States, in so far as non-inspected nursery stock, shrubs, ornamental trees, and any substances likely to carry the eggs of the gipsy-moth or the nests of the brown-tail moth are concerned.

It is safe to say first that the work which has been done since 1905 has

greatly restricted the spread of both species, and especially that of the gipsy-moth. It is safe to say further that the living conditions in the infested territory have been greatly improved.

Neither gipsy-moth nor brown-tail moth are longer to be feared as shadetree enemies or as enemies of orchards or gardens. Both have become relegated to the class of forest insects, so far as



Photo from U. S. Department of Agriculture CHRYSALIDS OF GIPSY-MOTHS WHICH HAVE BEEN DESTROYED BY PARASITES, PROBABLY Calosoma sycophanta (SEE PAGE 53 AND TEXT, PAGE 66)

their ravages are concerned, with the additional damage which the brown-tail moth does to summer resorts by virtue of the irritating rash produced on the skin of persons in its neighborhood by the hairs from the caterpillars.

FIGHTING LOCAL OUTBREAKS

But there has been some spread. The area now occupied by the brown-tail moth has been enlarged enormously toward the north and the east. The gipsy-moth has spread much more slowly, but still rather steadily, in practically all directions, though more to the north and east.

Four sporadic outbreaks of the gipsymoth have been found outside of the regularly infested territory—two in Connecticut, one at Geneva, N. Y., and the fourth (only discovered in January, 1914) in the vicinity of Cleveland, Ohio. The New York outbreak has been stamped out; the Cleveland outbreak will probably be stamped out this year; those in Connecticut are thoroughly under control, will not be permitted to spread, and with some certainty will be annihilated.

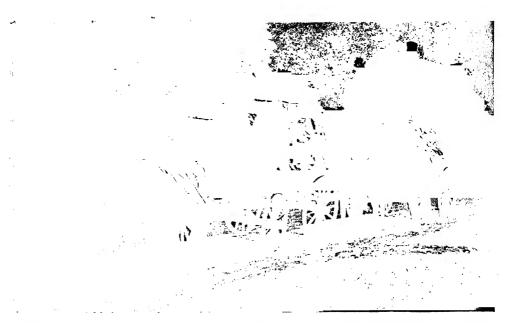
We have referred to the conditions

within the infested region as having improved. This has been due to actual exterminative work in the destruction of the egg-clusters of the gipsy-moth, in the burning of the winter nests of the browntail, in the destruction of the gipsy-moth caterpillars by spraying, by collecting them under burlap bands on tree trunks, where they are subsequently crushed, and by the general cleaning up of roadsides throughout the region.

A number of species of the imported natural enemies (see pages 51 and 53) have accommodated themselves to New England conditions, have increased and spread, and during the past year probably destroyed more than 50 per cent of the gipsy-moths and brown-tail moths which hatched in the central New England region. Moreover, a disease has attacked the gipsy-moth caterpillars, and another those of the brown-tail moth, and these diseases are apparently becoming more widespread and virulent.

STUDYING FEEDING HABITS

The parasites and the diseases are working in the woodlands as well as along



EXPRESS WAGON-LOADS OF EUROPEAN PARASITES OF THE GIPSY-MOTH ARRIVING AT THE LABORATORY AT MELROSE HIGHLANDS, MASS.



Photos from U. S. Department of Agriculture

I.IBERATING EUROPEAN PARASITES IN NEW ENGLAND WOODS TO DESTROY GIPSY AND BROWN-TAIL MOTHS

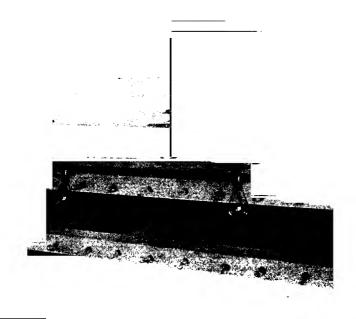


Photo from U. S. Department of Agriculture

TRAYS IN WHICH TINY FLIES, Schedius (EGG PARASITES), WERE REARED IN THE LABORATORY AT MELROSE HIGHLANDS, MASS.

Each tray is stocked with 1,000,000 gipsy-moth eggs. About 90,000 parasites were reared in each tray for colonization in the field in 1913 (see also page 66)

the streets and in the gardens and in the orchards, and the forest attack is becoming more and more alleviated by these means. But it is not intended that we should rely upon parasites and diseases alone to protect the forests. Careful studies of the feeding habits of the gipsymoth in particular have shown that, although when full grown it attacks almost all sorts of living vegetation, when young it can live successfully upon but a few plants. It must grow large and strong before it can eat and assimilate the leaves of most trees. A pure stand of pine or any other conifer, for example, cannot be harmed by the gipsy-moth, and the same may be said of hickory, maple, chestnut, alder, beech, and of mixed forests of these kinds of trees; but where a mixed forest contains oaks and gray birches, then it will suffer, because these two kinds of trees are the preferred food plants of these destructive leaf-eaters.

It results therefore that practical methods of thinning can often be adopted that will almost perfectly protect a mixed forest, and experiments have shown that mixtures of chestnut, ash, red maple, pine, and hickory are practically uninjured by the gipsy-moth. In these cases the oak scrub has been cut out and the larger oaks and gray birch have been removed.

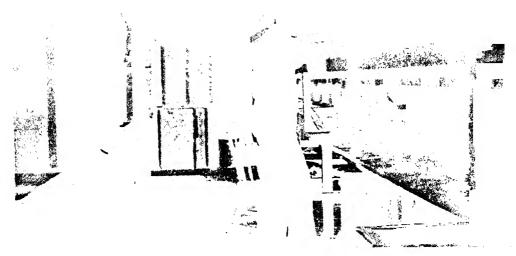


Photo from U. S. Department of Agriculture

INTERIOR OF PARASITE BREEDING SHED WHERE ONE MILLION TINY FLIES WERE REARED IN 1913: MELROSE HIGHLANDS, MASS. (SEE TEXT, PAGE 66)

In woodlands where the oaks predominate, however, the problem is a much more serious one and may mean ultimate reforestation.

In reaching the present rather promising situation, an enormous amount of work has been done. It must be realized that when, after a period of five years, the State of Massachusetts began once more, in 1905, to attempt to check the gipsy-moth, conditions within the infested territory were almost unlivable. The orchards and the shade trees were dying, the parks and the dooryards were stripped of all kinds of foliage in June, the wooded hillsides were brown when they should have been green, and in the villages and towns during the latter part of May and through June caterpillars were crawling everywhere-on the sidewalks, on the sides of houses, and even into houses. Methods of hand destruction were used in all of the infested towns. The new State law provided in general that each town should do its own work and should be recompensed by the State to the extent of one-half or more of the amount expended.

CONGRESS DECIDES TO HELP

When the moth began to spread beyond the boundaries of Massachusetts the Congress of the United States was importuned to make appropriations. By this time it had become evident that extermination was out of the question without the expenditure of enormous sums of money, and appropriations were subsequently made by Congress, not to attempt extermination, but to prevent, if possible, the further spread of both the gipsy-moth and the brown-tail moth.

The female of the gipsy-moth does not fly; its body is too heavy (see page 50);

and it was thought that the species spread only while in the caterpillar stage, by crawling upon trolley cars, upon automobiles and other vehicles, and upon the clothes of pedestrians, and that it was thus carried for the most part along the main traveled highways and thus gained a large spread.

In consequence, for several years the attention of the government workers was focused upon these main traveled roads, and the roadsides were cleaned up to a depth of from 50 to 100 feet, and the trees that were left were banded and sprayed, leaving the roadsides in such condition that there was no possibility of caterpillars falling upon passing vehicles or persons. It is undoubtedly true that by this means a far greater spread than has occurred was prevented.

A MOTH AËROPLANE

More recently, however, it has been discovered that a very important means of spread had been overlooked. As the young caterpillar of the gipsy-moth hatches from the egg it spins down on warm days suspended by a silken thread, is caught up by the wind and carried sometimes for miles before it succeeds in attaching itself to a tree or shrub. Large-scale experiments in the last two or three years, conducted by erecting enormous wire screens (see page 41) at various distances to the windward from infested woods, the screens being coated with a sticky substance, have shown that many young caterpillars are carried in this way to a distance of six miles or more.

This discovery has altered the methods of endeavoring to prevent the further spread of this insect, and as a result the operations are now carried on most intensively along the border of spread, especial attention being given to colonies that occur on hillsides, since young caterpillars from these colonies are more likely to be spread to great distances by the wind.

Another method of preventing the spread of the gipsy-moth is the inspection of products shipped from the infested region. This measure is very important and has been carried on with increasing care year after year. A perfected system has been inaugurated by the comparatively recently established



Photo from U. S. Department of Agriculture

THIS TUBE CONTAINS 1,600 TINY FLIES, Schedius kuvanæ

The flies, when liberated, will deposit their eggs in the eggs of the gipsy-moth, thus destroying the latter (see page 66).

Federal Horticultural Board, which has provided an absolute quarantine of the rest of the country against the region inhabited by the gipsy-moth and the browntail moth.

METHODS OF TRAVEL

This means that no plants from the nurseries of this region, no Christmas trees, and no plant products, such as railroad ties, cord-wood, telephone poles, and no objects of any kind upon which the egg-masses of the gipsy-moth might be laid or upon which the winter nests of the brown-tail moth might occur, can leave the territory without a certificate of inspection which certifies that they are free from these insects.

This, of course, means a great deal of work. The gipsy-moth passes the winter in the egg stage, in clumps of eggs numbering from 300 to 500, and these clumps are attached to all sorts of objects. Take, for example, the pile of boards shown on page 41. These boards are sawn and piled, and yet moths from the adjoining trees have laid their eggs all over them. This lumber being shipped out of the district would carry potential damage wherever it might go.

Let us suppose that an apple tree containing gipsy-moths were situated at the edge of a strawberry patch. The strawberries are picked, and then are often boxed under the shade of the tree, with the result that the crates in which they are placed may carry the eggs of the

gipsy-moth.

The brown-tail moth, on the other hand, passes the winter in silken nests in which leaves are usually enfolded, several hundreds of the young caterpillars being found in each nest. These nests are usually attached to the terminal twigs of trees, but are often found upon nursery stock; in fact, during 1909 many hundreds of these webs were brought in from France attached to imported nursery stock.

The female of the brown-tail moth, unlike that of the gipsy-moth, is a strong flyer, and spreads directly by flight more rapidly than it is as a rule carried in its winter nests. It happens in New England during June that on some nights the

brown-tail moth flies in such extraordinary numbers that of a morning the sides of buildings and electric-light poles appear almost white (see page 40).

They are attracted to light to a considerable extent, frequently enter houses and, what is worse, trolley cars and railway cars, and in the latter are apt to be carried for much greater distances than they could possibly fly. In the same way along the seacoast they will fly upon vessels just starting away, and so may be carried along the coast for very considerable distances.

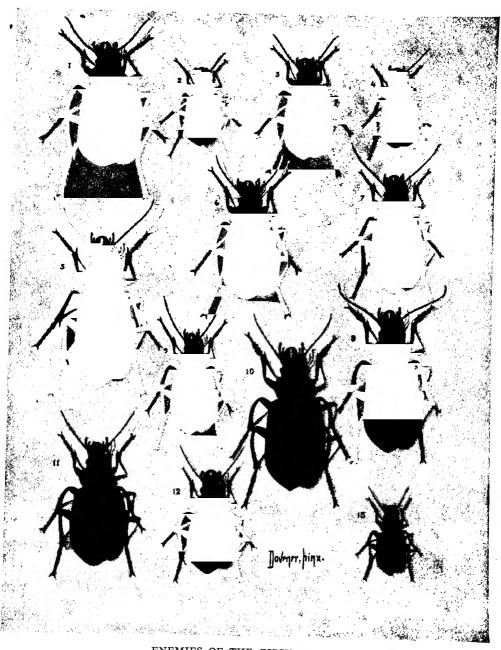
Just as this is being written the news comes that the brown-tail moth has been found during the past winter, probably as a result of last summer's flight, to have obtained foothold on Fishers Island, near the Connecticut mainland; at Orient Point, Long Island; at three points on Shelter Island, and still farther south, on the southern of the two eastern prolongations of Long Island, at six points between Sag Harbor and East Hampton. These points are all in New York territory, and the authorities of that State are fully alive to the danger, so that vigorous efforts are being made to exterminate these incipient colonies.

The brown-tail moth fortunately is not a very difficult pest to control. It is handled by late spring and early fall spraying with arsenicals, but more readily on low-growing trees and shrubs by cutting off and burning the characteristic winter nests, which are very conspicuous in the autumn after the leaves fall.

BROWN-TAIL RASH

In coming into Long Island territory the principal money loss which the brown-tail will cause is not by the destruction of foliage, but by the prevalence of what has come to be known as the "brown-tail rash," which keeps people away from summer resorts where this insect is prevalent. The hairs of the brown-tail caterpillar are finely barbed and brittle (see page 52), and where the caterpillars come in contact with the human skin these hairs enter the skin pores, break off, and cause a severe irritation.

Indeed, it is not necessary for the caterpillar to come in contact with the skin;



ENEMIES OF THE GIPSY MOTH

Several species of ground beetles brought to New England from different parts of the world to destroy the gipsy moth and brown-tail moth caterpillars. Only one of them has become established in New England.



THE BROWN-TAIL MOTH (EUPROCTIS CHRYSORRHŒA)

The male and female moths below, at right, female laying her eggs, at left. Winter nest above at left; pupæ above near center; larval nest in autumn at right; full grown caterpillar at center, with newly-hatched caterpillars at work on leaf just to the left. Egg-mass below at left.



A BEETLE DESTROYING THE BROWN-TAIL MOTH (CALOSOMA SYCOPHANTA)

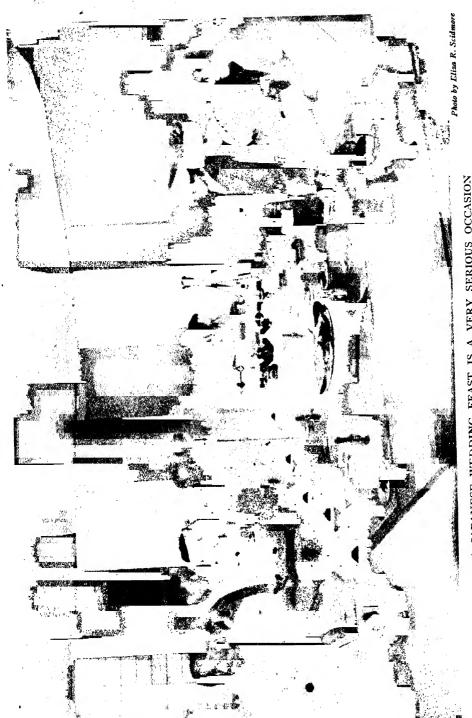
The most successful of the introduced enemies of the gipsy moth and brown-tail moth. Adult beetle destroying a gipsy moth caterpillar, below at left; pupa, under ground, at right; eggs, above left; gipsy moth pupæ and the Calosoma larvæ that destroyed them, above at right.

Photo by Elsza R Scidmore
THE YOUNG THE IN JAPAN

Some day this little poultry fancier may up into a soldier whose first desire will be that the fates may order his blood to be shed for his country, but as yet war's wild alarms have not stirred his soul.

When a formal call is at an end saying "goodbye" carries with it more ceremony, if not more sincerity, in Japan than in Western countries.

A CEREMONIOUS GOODBYE



A JAPANESE WEDDING FEAST IS A VERY SERIOUS OCCASION

The bride is the demure little lady second from the end on the right. To her right sits her mother and father. The groom is the third figure, on the left, and to his left sits his mother and father.



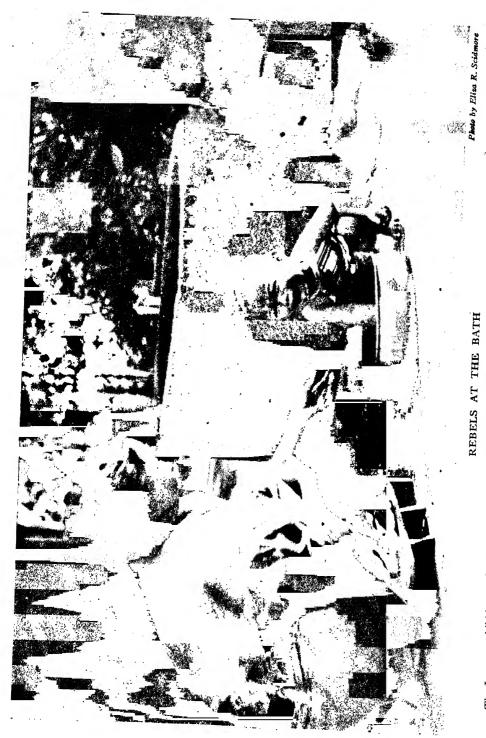
There is a provert in Japanese which says: "If you love your children give them lots of whippings; if you hate them, lots to eat."

This youngster seems to have had no evidences of parental "love" showered upon him lately, as he eats his "honorable rice."



THE RISING SON OF NIPPON

Young Japan is usually up early in the morning. His bed may not be as comfortable as the downy crib of Young America, his doll may not be as attractive as some on this side of the sea, and his rattle may not be of silver, but withal he usually is the picture of contentment and patience. A WAR STATE



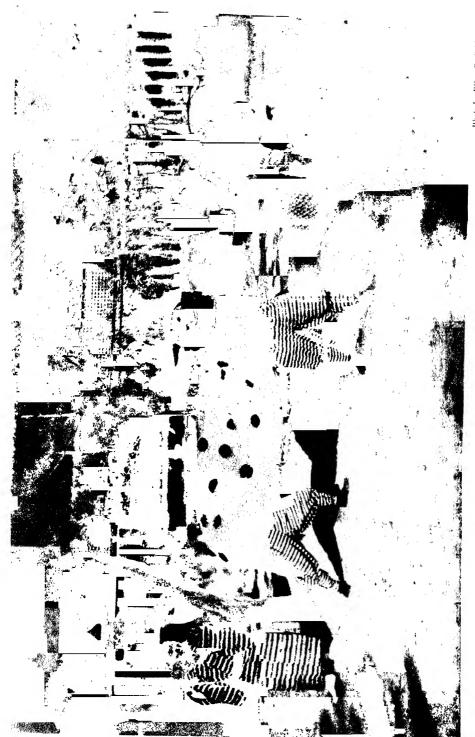
REBELS AT THE BATH

The Japanese child has no fine porcelain bathtub like the American baby possesses. His is a fittle brass pan, and in this particular instance.



YOUNG ARTISTS IN JAPAN

Before the paper-hanger comes at the frequent house-cleaning times in Japan the children are allowed to draw pictures on the old paper soon to be removed.



THE GARDEN FETE

Photo by Eliza R. Scidmore

No child's garden party ever pleased children more than the "animal dances" to the tune of the piper in the Japanese garden fete. It gives them a thrill that is equalled only by the American circus parade.



THE FLOWER GATHERER

In Japan one sees thousands of these bright-faced, flower-kimonoed little children among the blossoms of the garden, and feels that they live the spirit of their clothes and of the flowers.

EXPLORERS OF A NEW KIND

at certain times of the year hairs are actually floating about in the air. At the time of the caterpillars' change of skin, and particularly at the time of the spinning of the cocoon and the final change, certain of these hairs appear to become loosened in such a way that they are carried by the wind. Some people have been made seriously ill by this so-called rash and it is the cause of great annoyance.

The prevalence of the brown-tail in the New Hampshire woods has undoubtedly lessened the pleasure of many people in their summer camps. Persons engaged in removing the nests from the trees in the winter time, carrying them away to be burned, also suffer from this rash, although the trouble is not so great in the winter time as in the summer, since during warm weather the pores of the skin are more open and receptive to the hairs.

A large part of the popular feeling in New England that the brown-tail must be exterminated is due quite as much to the prevalence and annoyance of this rash as to the loss of vegetation from the work of the caterpillars. While it is true that most of the Long Island summer resorts are seaside resorts, where there is not much foliage, still there are others where the presence of the brown-tail moth will result in deterring visitors.

Further than the actual harm to the skin, the broken hairs which float in the air when the caterpillars or webs or cocoons are disturbed also cause severe internal irritation and poisoning. The death of one man employed in the moth work in New England was due to severe

internal poisoning of this kind.

Underclothes and bedding put out upon the line in caterpillar season collect the floating hairs and when used may result in serious poisoning. Doctor Tyzzer, of the Harvard Medical School, has investigated this rash, and concludes that the barbed hairs not only cause a mechanical irritation, but that they contain a poison which acts directly on the corpuscles of the blood.

No remedies suggested are wholly efficacious. Applications which are cooling to the skin, such as witch-hazel or alco-

hol, allay the irritation to some extent and reduce the suffering. No effective remedy has been found for internal irritation. A formula which has been in frequent use in New England and which is good as a skin application is:

Menthol	10	grains
Zinc oxide	2	drams
Lime water	8	ounces
Carbolic acid	15	drops

SOME NATURAL ENEMIES

Especially interesting and important among the imported natural enemies of both the gipsy and brown-tail moths are the Calosoma beetles, and notably Calosoma sycophanta (see page 53). We have a number of species of the genus Calosoma in the United States, but they are distinctly ground-beetles, whereas in Europe Calosoma sycophanta climbs trees readily, and its larvæ also climb the tallest trees in search of such leaf-feeding caterpillars as it may find crawling on the trunks and larger branches. Early attempts to introduce this insect into the United States through correspondents were failures.

One naturalist in the south of France once sent over a package in which he separated the individual beetles in match-boxes, putting in each box a meal-worm for food for the beetle. Unfortunately, on arrival in Washington, it was found that in every case the meal-worm had killed the beetle. There were many failures until the best method of sending by mail was discovered, and since that time it has been possible to bring over large numbers in living and healthy condition.

In all, 4,046 living specimens of C. sycophanta have been imported from Europe. Sixty-seven per cent of these beetles were liberated in field colonies and the balance were used for experimental and reproduction work. So successful has been this rather difficult work, under the direction of Mr. A. F. Burgess, of Boston, that this beetle now occupies a very large territory in New England, and undoubtedly several millions were at work last summer.

Everywhere through the woodlands about Boston these beetles were to be found in nearly all stages actively at work

and the brown-tail moth, as well as native species, while it was difficult to lift a piece of loose bark from an old tree without finding dead pupe of the gipsy-moth bearing the characteristic slit, shown on page 53, made by the jaws of the Calosoma larvæ.

A number of other species of Calosoma have been brought in from Europe, as well as from Japan and from different parts of the United States, and liberated in the infested territory. None of them, however, is worthy of mention in comparison with the Calosoma sycophanta, which has undoubtedly become a permanent denizen of our country and a most beneficial one. Millions of injurious caterpillars will be devoured by them this summer.

It will not be necessary to particularize about the numerous species of true parasites that have been imported. They have been brought in from many different countries, some of them by our own trained men sent out for the purpose, some by paid foreign agents, and very many of them—and this is most interesting—by officials of foreign governments, who have taken no end of trouble to aid us, not only on account of their interest in this wholesale experiment, but as an act of official courtesy to the United And it is worthy of note that one of the great amateur entomologists of Europe—M. René Oberthür, of Paris and Rennes—has been of the utmost assistance through his fertile suggestions and active work.

THE EGG-EATING FLY

One extfemely interesting parasite, however, may be especially mentioned, namely, the Japanese egg parasite of the gipsy-moth, known as *Schedius kuvana*, which the writer had great pleasure in naming after Prof. S. I. Kuwana, of the Imperial University at Tokyo. This parasite is a very minute Chalcis fly, so small as to undergo its entire development in a single gipsy-moth egg. Its existence in Japan was unknown until the demand for parasites for America began.

The first specimens were reared from Japanese eggs sent to this country in De-

cember, 1908, and others issued in April, 1909. They bred rapidly, laying their eggs in American gipsy - moth eggs brought into the laboratory and on through the summer at the rate of one generation a month.

By the first of the following year one million individuals were present in rearing cages in the field laboratory, and the following March the parasitized eggs were divided into 100 lots, each of which contained approximately 10,000 parasites, and were put out in colonies, while a large quantity of parasitized eggs remained and were placed in cold storage awaiting the appearance of fresh eggs of the gipsy-moth in the latter part of the summer. This hope was vain, however, and when the eggs were taken from cold storage not a single living specimen remained. By the end of 1910 hopes of the survival of the species in the field were almost abandoned; but, in spite of an apparent enormous decrease in their numbers at that time, the insect has finally accommodated itself to New England conditions and is breeding rapidly and spreading slowly from points where it succeeded in maintaining itself.

In the meantime, although the spread by natural means is slow, the minute adult flying but a short distance, it is being artificially spread and parasitized eggs are being taken into the laboratory, and as soon as the adults issue these are being taken to new localities in tubes (see pages 45 and 47). Each tube contains 1,000 adult Schedius; and two tubes, containing 3,200 adults in all, are used for each new colony. In the laboratory, trays, as shown on page 45, are used for the rearing, each tray being stocked with one million gipsy-moth eggs.

Still another egg parasite, known as Anastatus bifasciatus, which was sent over from Hungary by Prof. Joseph Jablonowski, also succeeded. One million five hundred thousand parasites of this species have been liberated during the past year. Eight hundred colonies were placed in towns along the western border of infestation, and the balance were liberated in a number of towns in the northern part of Massachusetts. During November, 1913, collections were

g party.

made in New Hampshire from the colonies of this species that were planted a year before, and examination showed that they were practically all successful. In these collections 100,000 parasitized eggs were secured and will be used this season for colonization in New Hampshire.

LOSING THEIR EVIL POWERS

On the whole, then, the outlook is favorable. The work of the government and the different States has resulted in bringing about infinitely better conditions in New England, so far as these pests are

concerned, during the past nine years; and while it is practically certain that both gipsy-moth and brown-tail moth will gradually spread to the westward, it is equally sure that the imported natural enemies will come with them and the wilt disease and the fungous disease of the brown-tail as well; and this, with the knowledge which we have gained as to the best handling of the pests, will prevent in all probability in any part of our country the disastrous results which we saw in Massachusetts in the years prior to 1905.

THE NEED OF CONSERVING THE BEAUTY AND, FREEDOM OF NATURE IN MODERN LIFE

By Charles W. Eliot

PRESIDENT EMERITUS OF HARVARD UNIVERSITY

HE past hundred years have supplied civilized mankind with a complete demonstration that the evils which attend the growth of modern cities and the factory system are too great for the human body to endure; yet these evils are the consequences, or results, of nineteenth-century civilization, and particularly of that form of liberty which the first half of the century developedindividualism. Within the last 40 years a different form of liberty, the liberty of association and collective action, has begun to check some of the evils fostered by individualism, and so to improve the human environment.

The sources of the evils which afflict the population massed in cities are partly physical and partly mental or moral. The collective energies of society are now actively directed to the amelioration of bad physical conditions, and considerable improvements in this respect have already been made; and more are in sight. The study, even, of remedies for wrong mental and moral conditions has hardly begun; yet these are the fundamental evils which must be eradicated, if improved physical conditions are to produce their desired effects.

It is therefore a very practical and urgent inquiry: What influences in the en-

vironment of civilized mankind make for mental health, for wholesome interests, for rational pleasures, and for exalting delight in the beauty, grace, and splendor of nature?

By far the most important social study today is the study of the means of improving men's emotion and thought environment from earliest youth to age. These means are both negative and positive—on the one hand they must shut out poisonous excitements and injurious pleasures, on the other they must develop all wholesome mental interests and enjoyable activities of observation, memory, and imagination.

IMPROVE OUR ENVIRONMENT POSITIVELY AS WELL AS NEGATIVELY

In order to cure the destructive evils of present urban life and the factory system, it will not be enough to restrict the vices, to diminish the pressure of poverty, to prevent destructive diseases, and prolong the average human life. The human environment must be not only negatively but positively improved; so that the whole people may have the opportunity to cultivate healthy tastes and interests, to acquire just ideals of pleasantness and beauty, and to learn the value toward tranquil happiness of that living with



A SPLENDID ELM OF CENTRAL MASSACHUSETTS

"The white elm is one of the largest and most graceful trees of the northeastern States. It is beautiful at all seasons of the year; when its minute flowers, harbingers of earliest spring, cover the branches; when in summer it rises like a great fountain of dark and brilliant green above its humbler companions of the forest or sweeps with fong and graceful foughs the plycid waters of some stream flowing through verdant preasures; when autumn delicately tints its leaves, and when winter brings out every de all of the great arching limbs and slender, pendalous buanches standing out in clear relief against the sky."—Sargent's Silva.

nature which city congestion has within a single generation made almost impossible for multitudes.

While the exclusion of bad influences needs to be unremitting, the good influences — fortunately for crowded urban populations—need not all be incessantly in action. An occasional holiday in a city park or garden, a week-end in the country now and then, or a fortnight's vacation in summer may make deep and lasting mental impressions, and supply both children and adults with wholesome material to fill the mind and direct its energies for months and years.

Hence the importance of better city and suburban planning, of public reservations of all sorts in city and state, and of national parks and monuments. All these modes of public action tell not only on the physical well-being of both urban and rural populations, but on the mental training of children and on the cultivation in the whole population of thoroughly healthy spiritual interests and uplifting enjoyments, both individual and social.

The profession of landscape architecture is going to be—indeed, it already is the most direct professional contributor to the improvement of the human environment in the twentieth century, because it is devoted not only to the improvement of housing and of town and city designing, but also to the creation, preservation, and enlargement of opportunities for human enjoyment of mountains and valleys, hills and plains, forests and flowers, ponds and watercourses, spring blossoms and autumn tints, and the wild life of birds and other animals in their natural haunts. are the things that city dwellers need to have opportunities to see and enjoy; these are the things that serve as antidotes to the unwholesome excitements and tensions of modern city life; these are the delights which, by occupying the mind and satisfying the spirit, keep out degrading thoughts and foul desires.

THE VITAL PROBLEM TODAY IS HOW TO FEED THE MENTAL HEALTH OF MULTITUDES

That good environment can modify favorably the effects of heredity is as

true of nations as of individuals. The vital question of modern life is how to feed the mental health and spiritual growth of multitudes. In the modern world life is tightly packed against life, and one life is interwoven with many others. Neither freedom of mind nor health of body can be secured in isolation; for both blessings the individual must hereafter be dependent on social or collective action.

The present evils of city life and the factory system—bad conditions which civilization has itself created-have developed their destructive forces in this country in spite of the schools and churches and of free political institutions, and in spite of many happy influences from art, poetry, music, and the drama. Clearly, society needs to develop a new and better environment for the general life—an environment favorable to both bodily and mental health and to the attainment of genuine happiness—not of mere momentary excitements, pleasures, and gratifications, but of solid contentment, and the lasting satisfactions of life enjoyed in quietness and peace. What are the means of compassing this end?

The readiest means is good planning of city, town, and landscape—first applied to areas still open, and then gradually to areas already occupied in undesirable ways. The new planning must take into account the interests of the whole community, as well as the interests of individual owners, the social or collective interest always prevailing.

The immediate objects to be sought are more light and air for dwellings, offices, shops, and factories, and thus a spreading out of cities; the transfer of factories to suburbs and to country sites along the lines of railway; the multiplication of playgrounds and open decorated areas, and above all the attachment of a piece of arable or garden ground to every family dwelling. Many of these results can certainly be attained; and indeed much work of this sort is already started in regulating the height of buildings, transferring factories and setting up new plants in smaller towns, enlarging school yards, and creating public parks and gardens.



GREAT HEAD: THE BOLDEST AND THE HIGHEST HEADLAND ON THE AMERICAN COAST FROM THE ST. LAWRENCE TO THE AMAZON

In occasional great winter storms the sea breaks over the top in sheets of spray—a wonderful thing to see

BEAUTY BRINGS CHEERFULNESS AND SOCIAL HAPPINESS

The housing problem for mechanics and operatives has already been solved in a business way by the English Garden City. In cities already too compactly built and with too lofty structures the improvement of the human environment must await better understanding of life's needs or change of taste in populations now unwholesomely congested. With the diffusion of knowledge concerning healthy and happy conditions for family life and the industrial life of the laborious masses this reformation of our cities and manufacturing towns will surely come about, but in coming about it must take account of something more than water supplies, sewers, and street lights; it must take account of beauty and of all that brings cheerfulness and social happiness.

The collective force of the community must further supply the means of making rural and landscape pleasures occasionally accessible to city populations by means of parks and gardens which illustrate all forms of open-country beauty and permit the occasional enjoyment by city families or larger urban groups of the outdoor pleasures which woods, shrubberies, gardens, and broad fields can give. All city dwellers greatly need these occasional delights, and Americans more than any other people; for they have become accustomed to an indoor life, and have come to rely on electricity as a substitute for sunlight, and mechanical ventilation as an equivalent for fresh air. Even the richer sort of Americans are often content to live in houses in which at least one-third of the cubical contents cannot be used without artificial light the year round, and to occupy offices in which electricity has to reinforce sunlight during the greater part of the year.

The proper use of the natural materials for creating on public ground fine land-scapes, gardens, and scenes of rural beauty involves an extensive study of these materials. The landscape architect must know how to use a near or distant prospect of hills and woods. He must know the trees, shrubs, and herbaceous

plants valuable in landscape or in gardens, or along walks and drives where thousands of people daily pass. He must know all the native materials for creating scenes of beauty, and all the imported materials which have proved available in the climate of the reservation he plans. And in order that the landscape architect may have the opportunity to study these materials, society must furnish places where they may be assembled, appropriately used, and thoroughly tested.

ENCOURAGE PUBLIC INTEREST IN ANIMAL AND VEGETABLE LIFE

In other words, the collective force of society should be used to provide and maintain living collections of these materials of landscape and garden beauty, where climate, soil, and scenery make it possible to assemble, cultivate, and exhibit them advantageously. The botanic gardens and arboretums which universities and governments maintain do not fully answer this purpose, although they contribute to it; because the lay-out of the botanical gardens and arboretums is made for a scientific purpose quite different from that which directs the thoughts of the landscape architect.

There is another source of keen enjoyment for city people which should be provided for when parks, gardens, and playgrounds are constructed for their pleasure, namely, the natural interest in animal life as well as vegetable life. Most men and nearly all women take a keen interest in bird life—in the migration, nesting, family life, and feeding habits of birds, both land birds and sea fowl. It is one of the advantages of suburban over city life that many varieties of birds can be seen and studied in the suburbs. The collective force of society, therefore, should be exerted to preserve all the species of birds which are profitable, not only for food and crop protection, but also for the stirring of human sympathy and delight in their colors, songs, and alert, sprightly ways. provision of sanctuaries for birds, of closed spaces as well as closed seasons, is a highly expedient use of the collective protective force of society against individual destroyers of bird life.



A TYPE OF ELM FOR WHICH NEW ENGLAND IS FAMOUS

This tree is doubtless several hundred years old and has many scores of years of natural life left, as the elm reaches a maximum age of about 500 years, grows to a height of about 120 feet, and attains a maximum diameter of about 11 feet. No other tree in the United States has been so extensively planted for ornament and shade.

The government of the United States has begun to use effectively its constitutional powers for improving the environment of the people by conserving broad scenes of extraordinary natural beauty and single beautiful or striking objects which, without the protection afforded them by government, might be lost to future generations. The national parks are reserved by act of Congress; the President, by executive order, may and does order the preservation of smaller areas or single objects under the title of national monuments. State legislatures have begun to provide State reservations, and have authorized municipalities, or special districts, to acquire both large and small parks. Chartered bodies of trustees have been authorized by State legislatures to acquire and hold considerable areas for perpetual public use.

THE PLAN FOR A NATIONAL MONUMENT AT MOUNT DESERT

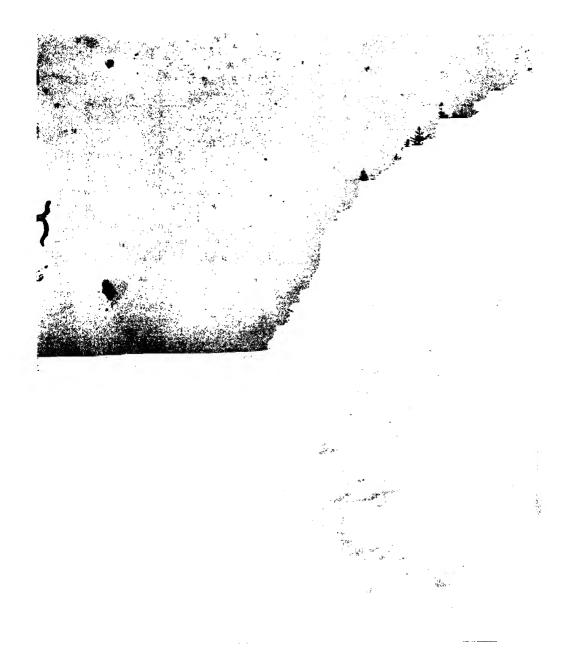
On the beautiful island of Mount Desert, not far from the northeastern extremity of the Atlantic coast of the United States, there is at this moment opportunity for establishing a national monument of unique interest and large serviceableness. The island is the loftiest piece of land on the Atlantic coast of the United States, and has a sharply differentiated surface of hills and valleys, a climate midway between that of the neighboring lands and that of the surrounding sea, abundant water, and in favorable spots a highly productive soil, well suited for growing a wide variety of trees, flowering shrubs, and herbaceous plants belonging to the temperate and subarctic regions of the world.

Private initiative and enterprise have long since demonstrated the peculiar fitness of the Mount Desert climate and soils for horticultural and arboricultural uses, and leading botanists and garden experts have testified to the remarkable thriftiness of plants grown upon the island, as well as to the unusual beauty and rich coloring of their blooms.

A body of trustees, called the "Hancock County Trustees of Public Reservations," has already acquired the wooded slopes and rocky summits of many of the, principal hills, and holds them for perpetual public enjoyment. Possession, too, has been secured by public-spirited private persons of considerable areas exceptionally fitted for the growth and exhibition of all varieties of trees, shrubs, and herbaceous plants which the landscape architect might use in developing all across the continent, in northern climates, parks and gardens for the enjoyment of city populations. Here, too, all the birdfood plants could be appropriately cultivated and bird sanctuaries provided. The cultivated tracts would have a noble background of rocky cliffs and lofty hills, and down the valleys and gorges visitors would look out from time to time over the near bays or the distant ocean. Here. in short, could be brought together under highly favorable conditions and in great variety the botanical and zoölogical materials of the landscape and garden designer.

If the government of the United States should set aside as a national monument a large area on this picturesque and unique island, it would help to consecrate for all time to the improvement of the human environment one of the most beautiful and interesting regions in the whole country; and in so doing it would take appropriate part in resisting and overcoming the destructive influences on modern civilization of urban life and the factory system.

The powers of the national government have thus far been exerted to these conservation ends chiefly in the Far West, where population is sparse and the evils of city life and the factory system are little developed. Is it not just and highly expedient that these beneficent powers should now be exerted in the East, where manufacturing industries occupy the major part of the population and the destructive effects of city life have long been manifest?



VIEW FROM THE GREEN MOUNTAIN TRAIL

One looks seaward over a vast ocean plain stretching forty-odd miles away to the horizon. The inlet on the shore is Otter Creek, a little harbor inclosed by bold, surf-beaten headlands, and one of the most picturesque spots upon the coast. On the right the county road continues on along the coast to Somes Sound, the fiord which another picture shows, and beside whose entrance the Jesuit settlement of 1613 was made.

THE UNIQUE ISLAND OF MOUNT DESERT

By George B. Dorr, Ernest Howe Forbush, and M. L. Fernald

OUNT Desert Island, a unique and striking landmark from the sea, was the first land to be approached, described, and named-with the name which it still bears-in the earliest recorded voyage of exploration made along the coast of Maine to the eastward of the Kennebec.

In the early days of September, 1604, when the poplar trees and birches of the northern forest were first commencing to turn to gold amid its then abundant pines and dark-green spruces, Champlain sailed from the eastward down that wild and unknown coast until the hold range of the Mount Desert hills, with their bare rock peaks and deep dividing valleys, iceeroded, rose before him. Turning then, he sailed up into the noble bay that bounds the island on the east and which still bears the name of Frenchmans Bay. and—nearly wrecking on the way, in gathering dusk no doubt, his big, lateensailed, open boat upon a rock that was

awash--anchored for the night. The next day, after having explored the upper bay to the Narrows, where a bridge connects the island with the mainland now, he sailed on around the deep, sheer headlands of primeval rock-unequaled on our coast—that oppose their surf-formed precipices to the open sea, and came into island-sheltered waters on the southern side, where he made friends with Indians, who presently guided him up the Penobscot River, the eastern extremity of whose mouth he describes the Isle des Monts Deserts as forming.

The lesser islands, islets, and sea-girt rocks he passed upon the way were so numerous, he tells us, that it was "marvelous to behold"; and among them some were very beautiful and contained fair meadows, while the oaks upon one side of the river bank as he ascends appear as though "planted for ornament"; on the other the pine forest grew.

THE "MAYFLOWER" OF THE FRENCH

Nine years later the French returned to Mount Desert, thither led by God, the Jesuit narrator says, across a dangerous and fog-hidden sea, to form for a brief while the only colony from oversea ever established by the French upon this country's northern coast in their long contest

with the English for America.

In a small vessel of a hundred tons, which Parkman calls the Mayflower of the French, laden with goats and horses, seed-grain, stores, and agricultural implements, the colonists set sail from Honfleur, on the coast of I'rance, in the first days of spring, 1613. It was late in May when they came to rest beneath the deeply shadowed cliffs and wooded hills of Mount Desert and lay in safety in a pleasant harbor on its eastern shore.

Landing there, they raised the cross, held mass, and named the place, in thankfulness for the guidance given them to so fair a spot, Saint Sauveur. Later, however, persuaded by Indians encamped beside the shore where North East Harbor is today, they sailed around to the mountain-guarded entrance to Somes Sound the one true fiord upon our coast-and there established their little colony upon a pleasant hillside sloping gently to the sea and bathed on either side with springs; upon the earth, "black, rich, and fertile," the grass grew "tall in places as a man." This place looked out to This place looked out to the southeast upon a sheltered harbor "where a fleet might ride in safety," but into whose peaceful waters an English foe came sailing one fair morning later

on and wrecked the colony.
"Thus," Parkman says, "in a semipiratical descent, an obscure stroke of lawless violence done at Mount Desert began the strife of France and England, of Protestantism and Rome, which for a century and a half shook the struggling communities of North America, and closed at last in the memorable triumph of the English on the Plains of Abraham.

THE COMING OF JOHN WINTHROP

Twenty-one years later still—upon the 8th of June, 1630—John Winthrop, bringing the charter to the Massachusetts



The mountains inclose it precipitously on either side as it passes through the granite range, while the depression which forms it nearly cuts the island into two beyond. It forms a magnificent natural harbor, deep enough to float the largest transatlantic steamers

colony at Salem and its appointed governor, sailed by between the island—whose lofty heights he makes the western "Cape," or boundary, of the Bay of Fundy—and Mount Desert Rock, finding there "fair sunshine weather and so pleasant a sweet air as did much refresh us; and there came a smell from off the shore like the smell of a garden."

That day there came a wild pigeon, too, and rested on his ship—a species now extinct through wanton slaughter—and he tells how they put the ship a-stays in 30 fathoms of water, and took "in two hours, with a few hooks, sixty-seven codfish"—and very great fish they were, some of them a yard and a half long and a yard in compass; and how a whale lay in their way and "would not shun them," so that they sailed by within a stone's throw of him as he lay spouting water, with his back hunched up a yard above the sea.

A GIFT TO THE NATION

Three centuries—a few years more or less--after Champlain sailed beneath the granite range of the Mount Desert mountains and the French colonists had broken ground upon the fertile shore, a group of summer residents, who had long found pleasure in the various beauty of the island and a restful home upon its shores, gathered in response to a call from Dr. Charles W. Eliot, then president of Harvard University, to associate themselves together for the purpose of conserving the wild, inspiring beauty supreme in its own way—the many-sided interest and open freedom of the nature which had meant so much to them.

Gradually the undertaking thus begun has grown, till now the association holds between five and six thousand acres on the island in one continuous reservation, which includes the highest mountain peaks and the greater part of the watershed of the high-lying lakes between them whence the water supplies of the residential portions of the island are chiefly drawn. The area also includes much forest land, with deep valleys which offer admirable shelter for wild life, open marshes and pools suitable for wading and aquatic birds, streams on which beaver formerly built their dams and

which would make fit homes for them again, and the best opportunity along the whole Maine coast for preserving and exhibiting in a single tract its native flora.

This ownership the association hopes ultimately to extend, as opportunity to do so at reasonable cost shall offer, till it includes the whole range of bold, ice-worn granite hills, from 12 to 15 miles in length, which extends across the island, offering magnificent views of sea and land, together with the cool lakes, the wooded valleys, and the one noble fiord on our Atlantic coast which lie between them.

The completion of this purpose will create a wild park of remarkable beauty, unique character, and great variety of landscape feature, whose permanent and best development in accordance with the spirit of their undertaking the members of the association feel will be provided for most wisely by placing it—except in special portions carefully selected and set aside for arboretum and other educational or scientific purpose—in the hands of the Federal government as a gift to the nation.

Saved to future generations as it has been to us, in the wild primeval beauty of the nature it exhibits, of ancient rocks and still more ancient sea, with infinite detail of life and landscape interest between, the spirit and mind of man will surely find in it in the years and centuries to come an inspiration and a means of growth as essential to them ever and anon as are fresh air and sunshine to the body.

MYRIADS OF LAND AND WATER BIRDS *

When America was first discovered the coast of Maine was the habitat of myriads of land and water birds. Champlain, in his account of his second voyage along that coast, tells of the multitude of fowls of the air which he beheld. Hakluyt, in his "Discovery of Norumbega,"

*The preceding paragraphs are by George B. Dorr; the succeeding paragraphs, until the heading "Mount Desert contains a greater diversity of plant life, etc.," by Ernest Howe Forbush, and the concluding paragraphs, beginning with the above heading, are by M. L. Fernald, Curator Gray Herbarium, Harvard University.

mentions particularly "the great plentie of foules." Rozier, in his narrative of Weymouth's voyage to the Maine coast in 1605, speaks of "many fowls of divers kinds" as breeding upon the islands. He mentions particularly eagles, hernshaws (herons), cranes, ducks, great geese, swans and penguins (great auks), crows, shrikes, ravens, mews, turtle doves (passenger pigeons), and "many other fowls in flocks unknown," and speaks of cranes especially as breeding on these islands. Levett again, in his "Voyage to New England," 1623, speaks of "a world of fowl" along the coast.

This coastal region is indeed wonderfully fitted to be a great nesting ground and feeding place for both land and water birds.

The coast-line is so broken with deep, irregular indentations and the islands lying off it are so numerous that from Casco Bay to the Canadian boundary it presents to the wash of the tides more than 2,500 miles of shore. All along the coast there are broad flats and saltmarshes extending deeply inland which are swept over twice a day by the tide's great flood, rising from 12 to 13 feet in the Mt. Desert region; and every recurring tide for ages past has brought and deposited upon these flats and marshes quantities of floating marine life, while countless animal and vegetable forms grow upon and in their fertile bottoms.

In the early days, when every tide went out, great multitudes of birds of many species found a bounteous repast spread for them along that vast stretch of coast. Yet, although food conditions for them are almost as favorable today as they were when Champlain first explored these shores, only a pitiable remnant of the birds remains.

MANY HAVE UTTERLY DISAPPEARED, BUT MANY MAY STILL BE PRESERVED BY PROMPT MEASURES

The continual hunting and shooting of birds throughout the Atlantic States and the maritime provinces, with the destruction of their nests, eggs, and young for food and commercial purposes, has swept the coast like a destructive storm, annihilating far the greater part of the bird

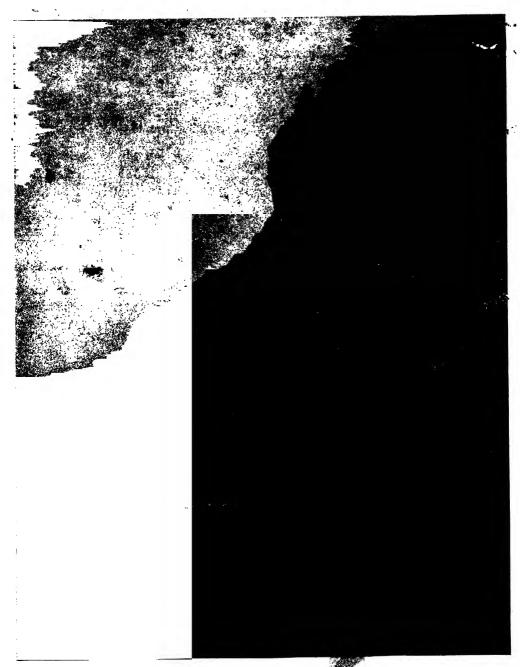
life that formerly existed there. The multitude of swans, snow geese, great auks, wild turkeys, and wild pigeons that were seen by the earlier explorers are gone, and with them are also gone the Labrador ducks, cranes, spruce partridges, ravens, and eskimo curlew, while many other shore birds and water fowl have become rare almost to disappearance, although prompt measures still would bring them back.

The Maine coast is not alone in this, for recent explorers tell us that northward along the unprotected coasts of Nova Scotia, Newfoundland, and Labrador the nesting wild fowl and shore birds are disappearing so fast that now the eastern coast of Maine, where occasional island colonies of these birds have been given some protection by the National Association of Audubon Societies, offers the best opportunity existing for saving from destruction the typical water birds which once bred so abundantly along the whole northeastern coast of North America.

It now seems as though the tide were turning and that the destructive evils of the past may at last be stayed. The recent action of Congress in enacting a national law for the protection of migratory birds gives encouragement to the hope that it may yet be possible to foster and gradually bring back to some measure of the old abundance and variety the valuable—and, once lost, irreplaceable—wild bird-life of this continent. But the enactment of laws alone will not secure results.

All who speak with knowledge now agree that no plan for the preservation of birds in any country can succeed unless adequate and well-placed bird refuges and absolute sanctuaries are provided, where all shooting or disturbance of the birds is prohibited, where the birds that breed locally can nest in safety, and where migratory birds of the farther north can find shelter, protection, and food in their migrations. Every year's delay counts heavily against the birds.

Over 900 million shot-gun cartridges are sold in the United States each year and more than 100 million in Canada. Great numbers of muzzle-loading guns



THE SEA-GULLS HOME

A seaward-facing cliff of immeasurably ancient Cambrian stone, formed of clays and sands washed down from a vanished continent older probably than life of any sort on land. These were deeply buried subsequently and turned by pressure into hardest rock, but the sea-laid strata still show clearly in the foreground.

also are used by foreigners, Indians, and people on the border-line of civilization, of whose loose ammunition no record of amount can be obtained, and great quantities of birds are slain by immigrants with cane-guns, snares, nets, bird-lime, etc. The forces of destruction are constantly increasing and the need of sanctuaries where no shooting will ever be allowed has grown urgent to the last degree.

THE PATHS OF THE GREAT BIRD MIGRA-TIONS CONVERGE AT MOUNT DESERT

The shape and geographical position of the continent of North America is such that during the migration seasons bird-life goes crowding up or down this country's coasts, both Atlantic and Pacific. This is due to the much greater width and vast extent of the continent to the north of us and to the great feeding ground and natural line of travel offered by the shore to both land and water birds upon their flight.

On the Atlantic coast from the Bay of Fundy southward this effect of concentration is particularly great and must in early days, when birds were plentiful, have made it, during the migration seasons, a marvelous sight.

A third great highway of migration flight lies along the Mississippi Valley, and along all three of these great natural routes it is necessary that bird reservations should be established. But extensive tracts have been already set aside for this purpose by the government along the Pacific coast, and reservations on a vast scale are now in process of establishment, through private gift, along the Louisiana coast to the westward of the Mississippi mouth.

It remains for us in the east, where the bird life was once so abundant and the need came earliest, to do like work; and nowhere is there work of more importance to be done, nowhere is the need of the present day so critical.

The tendency of most migratory birds nesting on the eastern third of the continent is to fly southeastward from their nesting grounds until they reach the coast and then to follow it on southward, guided apparently by prominent land-

marks spread along the coast, or to strike out presently across the sea to the Antilles.

When the autumn frosts come, migratory birds from Greenland, from atl the shores of Baffins Bay, from Labrador and Newfoundland, from the cultivated lands of eastern Canada and all the wild interior beyond, pour their diminished legions down toward the Maine coast; in the springtime they return and spread out northward from it.

Thus Mount Desert Island, unique in being the only mountainous tract thrust prominently out into the sea, offers an important landmark and admirable resting place for migratory birds of every kind—birds of sea and shore, the useful insect-eating birds of cultivated lands, of woods and gardens, the birds of marsh and meadow lands and inland waters.

THE BIRDS OF AT LEAST FOUR FAUNAL ZONES NOW BREED AT MOUNT DESERT

The fauna and flora of the coast-line at this point are largely of the Canadian type and its birds are represented here with corresponding fulness. Nevertheless, a number of Hudsonian plants grow upon the island also and form breeding places for certain birds characteristic of that northern area. This is one of the very few points on the Atlantic coast of the United States where portions of this far northern flora and fauna can be found at all, and it is the southernmost of them all

Following the coast up from the west and south, a number of the birds of the Alleghenian and transition zones reach the island also, and we thus find at least four faunal areas represented in summer at this unique spot, while a number of Arctic and other northern birds frequent the region in winter, at which season the Alaskan eagle and the snowy owl appear.

Remarkable opportunities exist here, accordingly, for inducing birds of strang kinds to remain and nest upon the island, where they can be fostered, studied, and protected. For the birds of farm and garden it offers conditions that might readily be made ideal in certain sections. The growing forest cover provides admirable nesting places for all woodland



THE OCEAN FRONT UPON ROUND PORCUPINE

An island guarding the entrance to Upper Frenchmans Bay. This island is the hard rock-core of a hill that once rose above the stream-worn valley of the present bay; for the coast of Maine is what geographers call a drowned one—an old land-surface sunk beneath the level of the flooding sea—and it is this which gives it its hold character and remarkable extent, the greatest in the country next to Florida.

birds. For the birds of inland and of tidal waters the place is singularly favorable, while the vertical cliffs may yet call back to nest the raven and the eagle.

No northern situation was ever better whited to grow a great variety of fruiting plants for bird food. The remarkable horticultural qualities of the island have Jong been recognized, and both wild and cultivated shrubs fruit there with an extraordinary profusion. In the deep valley, especially, which extends from the Bar Harbor region, and the great wooded heath to the south of it, through the wild mountain gorge with tarn-like bottom marsh and open pools that makes a natural highway for the birds between the northern and southern shores, there are wonderful sites for bird shelter-woods and bird-gardens.

In the fertile soil washed down into this valley from the granite heights above, open spaces may be planted with the native food-providing shrubs and trees, such as the alternate-leaved cornel, the wild pear that is so beautiful in its springtime flowering, the red-berried ilexes and richly fruiting thorns that bring such glowing color into the northern fall, interspersed with thick bushes suited for bird-nesting.

Here, too, there are excellent opportunities for growing along the banks of streams and ponds, near either entrance to this gorge, the seed-bearing herbaceous plants on which the marsh and water birds subsist, and an admirable chance for creating islands upon flooded marshlands which will form ideal breeding places for both land and water birds. Water in every form is here abundant in springs and streams and open pools while the deep, rich soil of the swamp and swale already produces plants in plenty to entice the birds that haunt such places, and little more is needed than to give these plants a chance to make their best development.

All through this valley and the adjoining one to the eastward, with its old beaver-pool beneath the wooded side of Newport Mountain, admirable opportunities may be found for such sheltered feeding places. Many more of the insect-eating song and other birds of New England

farms and gardens which winter in the south might readily be led to make their summer home upon the island, while the great variety of northern winter birds which migrate through this region would make it possible, at little cost, to feed and assemble here large numbers of them also in many species.

A BIRD STUDY STATION IS NEEDED

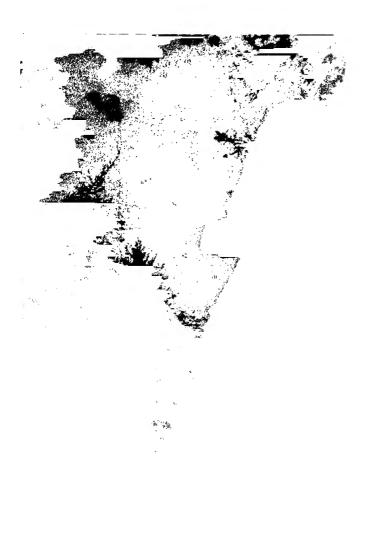
And here, of all places, an admirable opportunity presents itself for the establishment of a bird study station, combined with bird protection, such as has proved so valuable in Germany and has revolutionized the methods formerly in use there for the encouragement and protection of bird life.

At such a station the best methods of bird protection, food supply, and propagation would be studied out and given practical trial, and from such a station the results obtained would be published widely for the benefit of the country, while the interest and practical importance of the work done would, when once the undertaking was established, bring people in number to the island in summer time to study the methods practiced, or the birds themselves attracted to the spot.

Work along this line is greatly needed in America, to whose bird life the results obtained in Germany have proved, on experiment, to be only partly applicable: and carried out at Mount Desert, where and to the adjoining coast and islands so strong a tide of summer travel sets each year, and where so many people of influence and education, drawn from the country over, spend their summers, such work would have exceptional value, apart from the place's natural opportunity.

Nor would the presence of people in the reservation tend to drive out the birds, provided they were not molested, but help rather in extending the interest in bird life and knowledge of the birds. Some of the wilder birds are even now learning to live in cities where they are protected, and many birds might easily be attracted to a region so favorable for their shelter, sustenance, and nesting as this.

Mount Desert Island lies in the midst of a great chain of lesser isles spread



ON THE CADILLAC TRAIL ABOVE THE OCEAN DRIVE

An ancient sea-cliff cut by the beating surf of thousands, and probably tens of thousands, years ago, though now raised high above the ocean level by coastal uplift. The path along its base, named for the Sieur de Cadillac, one of the early French pioneers, is one of extraordinary picturesqueness.

broadly out along the coast on either side for 50 miles, and its dominating height and greater size make it doubly central. The establishment of the bird reservation now proposed upon this great coast landmark of the North Atlantic will mean not one important sanctuary only, but ultimately a far-reaching chain of island refuges along that coast — protected at little cost by local fishermen—where land as well as water birds may breed in safety.

Some of these islands already support considerable nesting colonies of terns in several species, of gulls, guillemots, petrels—"little Peters" walking on the water—herons, ospreys, with a few colonies of eider ducks and puffins. A few of these colonies, on islands lying to the seaward of Mount Desert, are now guarded by the Associated Audubon Societies, but speedy protection only can preserve the others from extinction.

The Mount Desert reservation, with its associated island sanctuaries, could not long remain an isolated work of bird protection on this great eastern highway of migration, but would form the first of a series of permanent bird refuges along the Atlantic coast of the United States which must eventually be established from Maine to Florida if the people of this country are to preserve what yet remains of the original bird fauna.

That some place in that region should be taken without delay for such a reservation cannot be questioned; and by accepting the important opportunity now offered on this island the Federal government would obtain immediately the best place possible for initiating a work long urgent on the Atlantic coast, and by whose neglect species of great economic value or exceptional beauty, like the passenger pigeon and the trumpeter swan, have been — hopelessly in the one case cited or practically in the other — but lately lost.

MOUNT DESERT CONTAINS A GREATER DI-VERSITY OF PLANT LIFE THAN ANY SIMILAR RESTRICTED AREA IN NEW ENG-LAND OR IN THE EASTERN STATES.

One of the commonest sights in the wilder districts of the northeastern United States is vast stretches of burned

and waste lands, left in this sad condition after the cutting of timber and intentional or accidental burning of the refuse.

Now it so happens that nearly if not quite all the native plants which originally inhabited the forested areas have a peculiarly modified root structure which renders it impossible for them to grow in any soil but the moist and sponge-like forest humus (leaf-mold).

The first effect upon the native vegetation, then, of clearing and burning the forested areas is the complete annihilation of countless individuals, representing hundreds of species of wild flowers and ferns, which make much of the original charm of the primitive forest. So complete has been the destruction of the humus layer by the cutting and burning of lands through many generations that it is well-nigh impossible to find within 50 miles of our large towns any areas of appreciable extent where the original wild flowers of the forest can now be seen.

This calamity, as it is viewed by lovers of nature, does not stop, however, with the mere destruction of the native wild flowers and ferns; but, through the upsetting of nature's equilibrium, a much more serious situation is evolved. Very briefly, the process is this: The cutting of the forests, with its consequent drying out or burning away of the humus (leafmold), destroys, as already stated, the native forest vegetation; the destruction of the native plants has its immediate effect upon the feeding and breeding of the native insects, which nature has through countless ages made dependent upon them and which rarely if ever become troublesome to the farmer.

The destruction of the food-plants of the native insects, depleting or locally exterminating the native insect species, again has its effect upon the native birds, which through ages have depended upon the indigenous insects. The destruction of the native vegetation, furthermore, has a direct effect also upon the native birds and mammals, in that their natural breeding haunts and hunting grounds are destroyed.

Whether or not the gradual reforesta-



ed 's-form today the A deep gorge plowed by the seaward flowing ice-sheet through the once solid granite mass whose boldly sculpture. Mount Desert Mountains. The view is taken looking northward from the precipitous side of Pemetre Mountain. Eagl supply for Bar Harbor and the northern each of the island is chiefly drawn, shows in the distance.

tion of our burned or deforested areas will in the course of hundreds or thousands of years develop a sufficient humus carpet to support again the original prest flora and with it the forest fauna, it is of course impossible to say. It is, however, unfortunately apparent that, should that time ever come in the future history of our continent, the original native plants and animals will have become so depleted that the task of resettling future forests with indigenous life will be an impossible one.

It has, therefore, long seemed to the writer that the only way in which to conserve for the enjoyment and study of future generations any portions of our country which by good fortune are still somewhat in their natural condition is the reservation of all such tracts as may properly be set aside, with the explicit stipulation that they be left essentially in the hands of Nature herself to care for.

This brings me to the crucial point: where is the best spot, if only a single spot can be thus preserved, for the perfection of this ideal? A detailed knowledge of the geography; the flora, and to some extent the soil conditions of eastern North America, acquired through 25 vears of active exploration in New England, the Maritime provinces, Quebec, Newfoundland, and Labrador, naturally brings several regions to mind; but as a single area within the possible reach of this hope, the Island of Mount Desert, with its adjacent islets and headlands, stands out as offering the greatest natural diversity.

This comes obviously from the fact that Mount Desert is the highest land on the Atlantic coast of North America south of the Gulf of St. Lawrence, its hills reaching altitudes of almost montane character.

The exposed headlands and bogs of the Mount Desert region support between two and three hundred species of plants which are typical of the arctic, subarctic, and Hudsonian regions of America, and which on the eastern coast of New England or the alpine summits of the White Mountains reach their actual or approximate southern limits—such plants, for instance, as the black crowberry (Empetrum nigrum), the

baked-apple berry (Rubus Chamamorus), the creeping juniper (Juniperus horisontalis), the Greenland sandwort (Arenaria granlandica), the rose-root (Sedum roseum), and the Banksian pine (Pinus Banksiana).

But the flora of the Mount Desert region is not by any means entirely arctic or subarctic. There we find essentially all the common plants of the Canadian Zone, and mingling with them in sheltered nooks or meadows or on warm slopes, many scores of plants which reach their extreme northern or northeastern limits on Mount Desert or the immediate coast—such plants as pitch pine (Pinus rigida), the bear oak (Quercus ilicifolia), the sweet pepperbush (Clethra alnifolia), the sweet pepperbush (Clethra don verticellatus), the meadow beauty (Rhexia virginica), and the maple-leaved viburnum (Viburnum acerifolium).

This extraordinary accumulation within one small area of the typical plants of the arctic realm, of the Canadian Zone, and in many cases of the southern coastal plain, cannot be duplicated at any point known to the writer.

In its rock and soil composition Mount Desert offers a most attractive possibility. Much of the island consists of granitic rocks, with their consequent acid soils; but the soils derived from some of the metamorphic series, slates and shales, are, judging from the native vegetation, of a basic or even limy character, and many of the swamps are covered not with the heath thickets of acid bogs, but with the characteristic grasses and sedges of sweet areas.

Several plants of the island, sometimes of rock habitats, sometimes of swamps, suggest themselves at once as species, which in their wide range show a strong preference for sweet or limy habitats: the shrubby cinquefoil (Potentilla fruticosa), the showy lady's slipper (Cypripedium hirsatum), the hemlock parsley (Coniosclinum chinense), etc.

These features are sufficient, it would seem, to indicate the remarkable possibilities for the future if a tract like Mount Desert can be preserved from the destruction of its natural charms by the judicious guarding of what it now possesses and the re-introduction of what it



OTTER CLIFFS

A splendid granite headland split into huge, titanic blocks by the northern winter's frost and exposed to the unbroken sweep of ocean storms. The famous ocean drive skirts the rocky shore beyond, and the sand beach, which lies between it and Great Head, shows in the distance on the right.

has lost, or presumably lost, both plants and animals.

The location of the island as the play-ground, habitual or occasional, of a vast and highly intelligent portion of our population also renders it remarkably appropriate for such a natural reservation; and if such a reservation could be established with emphasis laid upon the redevelopment and maintenance of natural and indigenous conditions, its influence upon the intelligent peoples of America would be far-reaching; for it is inconceivable that lovers of nature could

enjoy such an ideal area, with its unmolested wild flowers, ferns, birds, and mammals, and with the full beauty of nature everywhere displayed, without desiring and providing a similar blessing—according to the varied opportunities that offer—for themselves and their children in other parts of the nation.

It is therefore earnestly hoped that those who have it within their power will take the proper steps to insure the preservation and true conservation of the area so generously placed at their disposal.

A BOOK OF MONSTERS

By David and Marian Fairchild

One year ago the Geographic printed a series of remarkable photographs of "Monsters of Our Back Yards," by David Fairchild. The series of pictures and the article accompanying them aroused so much comment and stimulated such an interest in the study of these important but tiny creatures that the National Geographic Society urged Mr. Fairchild to photograph more of these monsters. This he has done, and seven additional photographic enlargements are printed here. For the benefit of those readers who are particularly interested in the subject, the Society has arranged for the publication, in book form, of more than a hundred of Mr. Fairchild's pictures of spiders, hornets, wasps, ants, bees, bumblebees, red and black ants, grasshoppers, locusts, cricket-on-the-hearth, cockroach, dragon-flics, squash-bug, lantern fly, crane fly, insect hawks, soldier termite, mosquitoes, butterflies and their larvæ, moths, caterpillars, June-bug, ground beetle, clover-leaf weevil, blister beetle, cucumber beetle, scarab, etc., etc.

Each creature photographed is magnified so many times that few details of the external anatomy escape observation; and as one closely examines the pictures, which sound a new note in the layman's study of nature, he is at once interested and amazed at the new world it discloses and cannot help a curious fascination in learning, for instance, of the existence of the delicate antennæ which enable the cockroach to feel danger before it is seen, or of the wing-piece music-box with which the male cricket calls to its mate in the grass, and other strange and wonderful mechanisms of nature which stand out under the powerful microscope.

The authors tell the life story of each "monster" they present with a fidelity to fact that satisfies the scientist, and at the same time they have invested each "biography" with a charming touch of human interest which takes the reader off into the wonderland of his dooryard and gives an introduction to a new world second only in importance to our own, when measured by the vast effect it has upon human affairs.

The book should be in the hands of every child and adult who would know the wonder world which touches us on every side. As only a limited edition has been printed, those desiring copies should send in their reservations at once on the blank form printed elsewhere in the Magazine.



CREEN-HEADED HORSELY (Tabenus punctifer)

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There are nearly two hundred species of horseflies in North America, and this creature represents one of the commonest forms. The bands of iridescent green and copper and purple across its enormous eyes make it a beautiful creature to look upon. We never used to think the blue of flies was anything worse than annoying; but recently, since we have discovered the danger of letting the germs of disease into the blood streams of our bodies, we have come to see the grastly possibilities which lie in the piercing mouthparts of these flies. They suck the blood of animals whose blood streams may be swarming with disease germs, and then fly directly to our houses and puncture our skins with a beak covered with these germs, which slip off into our veins. Until we know that the diseases of the birds and field mice, the coons and 'possums, and other warm-blooded heasts, of a locality are harmless to us, or that it is impossible to transmit them to human beings, it is just to look apon these blood-sucking creatures as winged hypodermic syringes laden with disease. Photo and note by David and Marien Faireland. HE pictures of monsters are portraits of creatures which are as much the real inhabitants of the world as we are, and have all the rights of ownership that we have; but, because their own struggle for existence so often crosses ours, many of them are our enemies. Indeed, man's own real struggle for the supremacy of the world is his struggle to control these tiny monsters.

The plague of the Middle Ages, which spread like some mysterious supernatural curse over Europe and carried off millions of people, the yellow fever that has haunted the coasts of South America, the malaria which has strewn the tropics of the world with millions of graves, have been caused by the activities of two monsters so universally present in our homes as to have become almost domesticated creatures—the flea and the mosquito. During these last two decades these have come under our control, and the flies which leave a colony of germs at every footstep will not much longer be tolerated; indeed, every creature that bites and sucks our blood or that crawls over our food and dishes has been placed under suspicion.

Man struggles against these tiny monsters not only for his life and health, but for his food as well. Almost every cultivated plant has its enemy, and some of them have many. The bugs alone, which stick their beaks into all sorts of plants to suck their juices, would starve man out in one or two brief seasons if they in turn were not held in check by enemies of their own. The chinch-bug alone has demonstrated its power to devastate the wheat fields. The bark-beetles that girdle square miles of forest trees, the moths that destroy their foliage, the creatures that burrow into the fruit and fruit trees, the gall-forming flies that form galls on the roots of the grape-vines, able to destroy the revenues of a whole country, the beetle which strips the potato of its leaves, the one which infects with its dirty jaws the melon vines of the South and turns the melon patches brown these are a few of the vast array of our enemies It would require a book much larger than this one just to enumerate those well known.

It should make every American proud to know that it is the American economic entomologist who has, more than any other, pushed his way into this field and shown mankind how to fight these monsters which destroy his food, his animals, and himself.

But all these fascinating little creatures are not our enemies. We must not forget that man has domesticated certain of the insects, and that gigantic industries depend upon them for their existence.

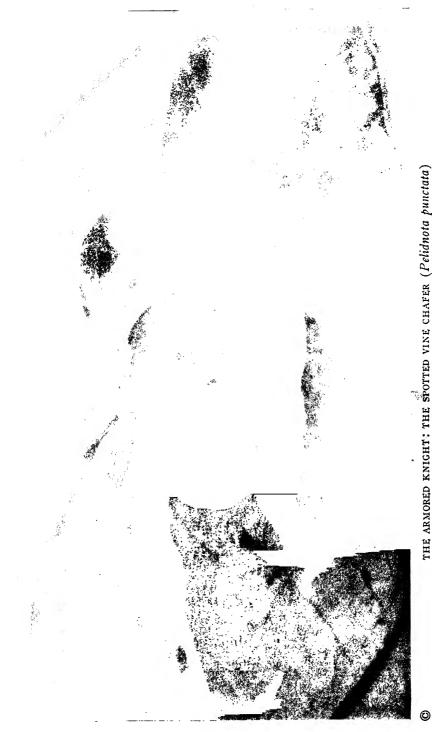
The honey-bee furnished mankind with sweets during the generations preceding the discovery of the sugar-cane, and the silk-worm furnishes still the most costly raiment with which we clothe ourselves.

The friends we have in the insect world are those which destroy the pests of our cultivated crops, like the Australian lady-bird beetle, which has been sent from one country to the other to keep in check the fluted scale which is so injurious to the orange orchards, and the parasites of the gipsy-moth, which in Europe helps to keep under control this plague of our forest trees, must certainly be counted as our friends.*

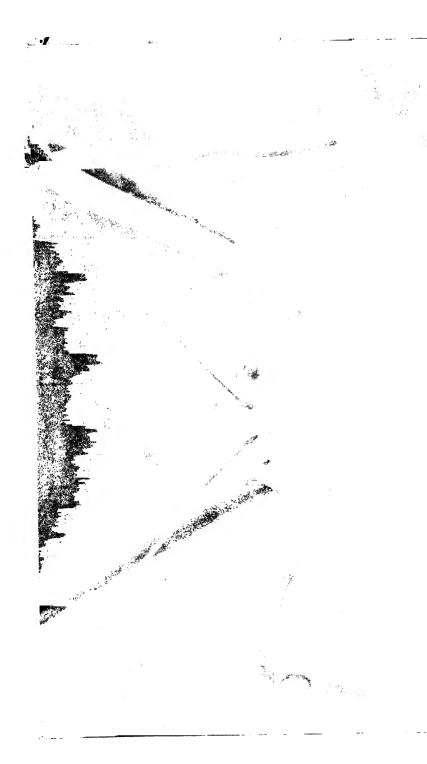
Also they are our friends if, like the spiders, they kill such monsters as suck our blood or make our lives unsafe, or, like the great hordes of wasps and hornets, wage unending warfare against the flies, but which, because they attack us personally if we come too near their nests, we kill on sight. Strangely enough, it is often these same stinging insects which help us by fertilizing the blossoms of our fruit trees. Indeed, many plants are so dependent on these little creatures that they have lost the power of selffertilizing, and thousands of species of trees and plants would become extinct in a generation without their friendly aid.

The ancestors of some of the creatures pictured in "The Book of Monsters" were buried in the transparent amber of the Baltic many thousands of years ago, and the fossil remains of others date back a million years or more; but while man has been developing his surroundings from the primitive ones of savagery

* See article by Dr. L. O. Howard, entitled "Explorers of a New Kind," printed on pages 38-67 of this Magazine.

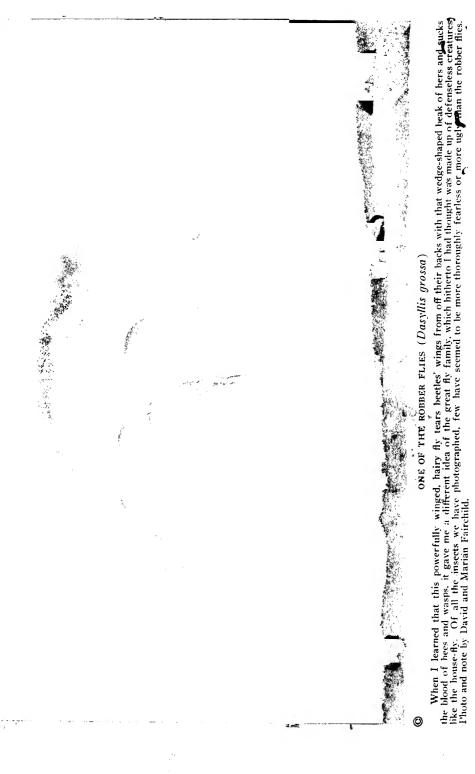


over them polished covers as hard almost as steel and fitting as closely as the engine covers of an automobile. When one thinks that man frast just begun to fly, whereas the beetles flew perhaps a hundred million years or more ago, these wings and their most perfect chitisged wing covers are deserving of our wonder and of our admiration, too. Photo and note by David and Marian Fairchild. How often one sees lame butterflies limping along in their flight because their wings have been injured by the rose bushes or by striking against the pine needles, or have been nipped by some hungry bird. The beetles, when they alight, fold up carefully each delicate wing close down



THE KATYDID (Scudderia)

them can tell from which direction the sounds come. Its long muscular legs enable it to jump great distances, and its wings not only enable it to first them can tell from which direction the sounds come. Its long muscular legs enable it to jump great distances, and its wings not only enable it to first sound is made by half opening the form wings and closing them again rapidly. While the wings are opening no sound is produced; as they close the characteristic sounds so like the words "Katy did" are made. Photo and note by David and Marian Fairchild. How marvelously equipped such a creature as this is to live! The great eyes, with many facets, enable it to see by night as well as by day. fore leg, just below the knee, is a dark, sunken area-the ear-with which it can probably hear sounds too faint for our ears, and by moving Its long, slender antennæ catch the faintest odor, and probably are sensitive to a host of perfumes that we do not know.





THE DRAGON-FLY AND ITS VICTIM (Macromia)

Needham hasafed the larve on bits of meat. Sharpe, the British authority, has bush, and Westwood believes he saw the same individual hawking for several weeks ps turned it around and around in the mouth. A few seconds throat had drawn out all the blood, and the fips threw out a ball-like mass made up of the fly's wings, legs, and crushed to opened again for more. One entomologist has said that in two hours a dragon-fly-will eat at least forty house-flies, and Doctor Howard says that, if starwed for food, it will eat up its own body. Perhaps some one will find a way to domesticate this creature and make gs. and, catching a fly that buzzed about the table, dropped I watched it disappear underneath its great upper As a first step, Needham has fed the larvæ on bits of Photo and note by David and Marian Fairchild. caught the dragon-fly whose picture is shown here, I held it by the Vithout a moment's hesitation its mouth opened wide and closed could hear its shell crack as the powerful jaws and low only and the sucking throat had drawn out all the blood, and the dragon-fly returning again and again to the same I it live upon the house-fligs around the house. lip and almost fancied body skeleton. it in its observed

NOT GOOD TO EAT

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Have you never wondered at the temerity with which certain of these slow-moving, helpless creatures expose themselves to the attacks of their enemies? In a world so full of hungry, winged beings it does seem strange; and when the markings are black and white, or some such striking color in contrast with the leaves or bark, the temerity seems even more extraordinary, until one learns the simple fact—these creatures are not good to eat. What a protection! It would seem to rival the sting of the bumblebee, the poison fangs of the spider, or the venom of the centipede in its efficacy as a protective weapon. Not good enough to eat! Supposing that the fly and the mosquito were equipped with some flavor distasteful to the insectivorous birds, if cattle were not good to eat, nor sheep, nor hogs, nor any living, breathing things; what a change There, would be in a world like ours! And yet to chemists there is very little difference between some compounds that are good to—at and others that are deadly poison, no greater than that between the poison bitter almond and the sweet one of our dinner table. "Not good ehough to eat, not seen pecking at it. Photo and note by Lavid and Marian Fairchild.

THE KING GRASSHOPPER (Hippiscus, sp.)

This young king grasshopper is probably twenty days old and its wings have not developed, but it can jump a hundred times its length at a leap. When its wings grow and its internal air sacs fill with air it can sail away for miles. One species of this great family can sail for a thousand miles before the wind, and they go in such numbers that they make a cloud numbers that they make a cloud number strate. Its great front lip hides a pair of jaws as effective as a hay-chopper, and it has an appeinte as voracious as that o a hippopolamus. This voraciousness and these jaws are what have made several of its relatives the plague of mankind. They multiply in such they are before the every living green thing for thousands of square-miles disappears down their throats, leaving the country numbers at the great famine of Egypt, mentioned in the book of Exodus; the grasshopper years of Kansas, which runed thousands of they are also as the country of the great famine of Egypt, mentioned in the book of Exodus; the grasshopper years of Kansas, which the migrators families on bur plains, and more recent devestations in Argentina and South Africa are examples of the tremedous effects which the migrators focus that he proposed and the proposed of hundreds of facts, I cannot help thinking that he represents a creature quite as fascinating and actually note the experiences of a hitetime into a few brief months. Photo and note by David and Marian Bairchild.

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to the almost inconceivably complicated ones of civilized life, these creatures, most of them at least, seem to be leading essentially the same kind of lives that they led hundreds of thousands of years ago.

. They have powers which neither man nor any other mammal ever dreamed of

having.

Some have powers of flight which enable them to sail a thousand miles before the wind. Others can jump a hundred times their own length. One of these monsters can manufacture a liquid rope as easily as mammals produce milk, and with it weave aërial nets to trap their pray, or by attaching it can drop from the dizziest fleights without danger, and when the rope has served its purpose they eat it up.

Their weapons of defense are comparable to the deadly ones that only poisonous serpents have. If they were larger they would be in fact what legend pic-

tures the dragons to have been.

The unthinkably old germ plasm of these species produces creatures which act with a precision of purpose and a degree of absolute self-sacrifice which cannot fail to stagger the most conscientious of the human race. They might even make one wonder whether the fulfillment of biological life does not consist in sacrifice of the individual for the good of the species to which it belongs.

Certain it is that human thought is now drifting away from the consideration of the individual and is coming to pay more attention to the species and the things which affect its development. This is a picture-book produced in the playtime hours of two busy people. It is a collection of actual photographs of a few of the small-sized monsters which inhabit

the tail grass, the flower garden and vege, etable garden, the pines and oaks of a place in the woods of Maryland.

If it should show to others a world of new and fascinating things it would be simply doing for them what the taking of the photographs has done for us—opened the door into a realm of real life, of a terrible struggle to live, which is as full of fascination as the dragon tales of old Japan. At the same time it makes us realize what vast and yet untouched fields of material value lie in the efforts man is making to outwit and circumvent, and even perhaps to exterminate, such of the monsters as encroach upon his own environment.

If you compare these photographs with those to be found in most books on insects you will find that they differ in several particulars They are all either front views or side views of the creatures, whereas those in books on entomology are generally views from above. Imagine a book on the horse in which only top views were shown, or a guide to a zoological garden illustrated with the various wild beasts photographed from above. It is true that, being so much larger, we generally look down at these monsters; but a mouse also generally runs along the floor or under our feet, and yet a zoologist pictures it from the same point of view that he does an elephant. Crows look down upon us, yet I imagine that no one will admit that the crow's impression of human beings is as correct or as interesting as that which we have of ourselves. Every creature has a right to be portrayed from its own level, and the reason these photographs are unusual is because they carry out this principle and do each creature justice.

